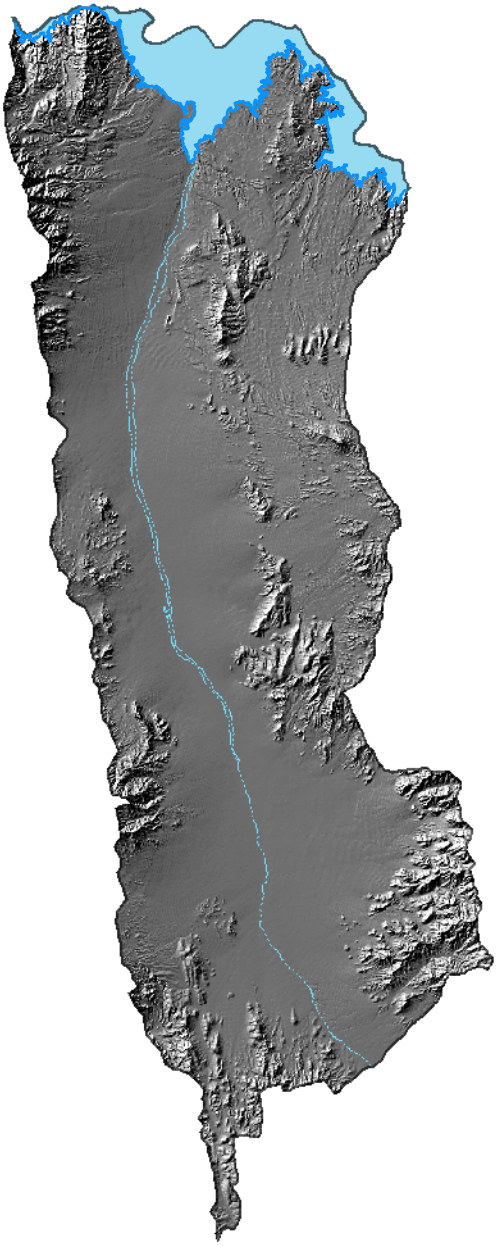
Arizona Department of Water Resources
Hydrology Division



Preliminary Estimate of Ground Water in Storage for the Detrital Valley Ground-water Basin Mohave County, Arizona

Open-File Report Number 9

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Introduction

The Detrital Valley Ground-water Basin is located in northwestern Arizona in Mohave County. The northern portions of Mohave County, Arizona are expected to undergo rapid residential development in the near future. The areas expected to undergo development include the Detrital Valley, Hualapai Valley, and Sacramento Valley Ground-water Basins. The projected development in northern Mohave County has created a need for updated information about the region's water resources. To update and improve the ground-water data available for northern Mohave County, the Arizona Department of Water Resources (ADWR) started a series of water-resource investigations in the Fall of 2005 focusing on the Detrital Valley, Hualapai Valley, and Sacramento Valley Ground-water Basins. This is the first in a series of preliminary reports on the water resources of the northern Mohave County and examines the estimated ground water in storage for a selected study area within the alluvial portion of the Detrital Valley Ground-water Basin (Figure 1). To update and improve the ground-water data available for the Detrital Valley Ground-water Basin, ADWR conducted a detailed gravity survey of the basin and a basin-wide water-level sweep in the Fall of 2005 and Spring of 2006.

This open-file report is intended to present a preliminary estimate of ground-water in storage in the Detrital Valley Ground-water Basin, and was undertaken to meet ADWR's immediate need for a more refined estimate of ground water availability for the Assured and Adequate Water Supply Program (AWS). The fieldwork undertaken for this report also supports a more extensive regional study of the Detrital Valley Ground-water Basin being conducted by the United States Geological Survey (USGS) on behalf of ADWR and Mohave County. The results of the USGS study are expected to supplant the estimate made in this report. A generalized description of the hydrogeology of the Detrital Valley Ground-water Basin can be found in Dillenburg (1987).

Purpose and Scope

An important outcome of the investigation is to generate a current estimate of the amount of ground water in storage for the Detrital Valley Ground-water Basin. The amount of ground water in storage to 1,200 feet (366 meters) below land surface (bls) is important to assist in evaluating the ground-water resources available in the basin for the AWS Program. Previous estimates of ground water in storage to 1,200 feet bls for the Detrital Valley Ground-water Basin are about 1 million acre-feet (Freethey and Anderson , 1986; ADWR, 1988). As described later in this report, ADWR used water-level data, depth-to-bedrock data, and an assumed extent of a regional extensive clay unit to estimate the amount of ground water in storage to 1,200 ft (366 m) bls in the Detrital Valley Ground-water Basin. Additional storage estimates were also generated for 1,500 ft (457 m) bls, and 2,000 ft (610 m) bls.

Depth-to-Bedrock Methodology

Gravity surveying is a common and well-established geophysical technique for determining depth-to-bedrock in the alluvium-filled basins of Arizona. This technique requires that a lateral density variation occur in the shallow subsurface across a basin, and assumes that this density variation is caused by bedrock having a higher density than the alluvium filling the basin. This situation exists in the Detrital Valley of northwestern Arizona. To properly employ this geophysical technique, a large number of relative gravity data measurements must exist throughout the basin and within the bedrock areas surrounding the basin. This was not the case in the Detrital Valley prior to ADWR's gravity data acquisition.

The primary purpose of ADWR's gravity survey work was to establish new relative gravity measurements in areas where no measurements previously existed, or where the spatial density of historic measurements was low. The goal of this effort was to create a database of relative gravity measurements, sufficient in number and extent, so that a useful depth-to-bedrock model could be created.

310 new gravity stations were established during 4 days of surveying in November 2005 and February 2006. One additional field day was used for doing gravity base ties. Gravity data were collected at one-mile intervals along existing roads and passable 4x4 trails (Figure 2). This resulted in an almost evenly spaced grid in the southern half of the basin and an irregular spacing in the northern half of the basin where access and roads were limited. To speed up data collection, data were not collected in areas where previously established gravity data existed.

Previous Work

Previously collected gravity data were obtained from the Pan-American Center for Earth and Environmental Studies (PACES) and from HydroGEOPHYSICS, Inc (HGI) (Figure2). PACES contains a gravity dataset collected from multiple sources and is available online at http://paces.geo.utep.edu. There were 1214 gravity points used from the PACES database. Four points were removed from the dataset due to obviously erroneous gravity values. The HGI data consisted of 196 gravity points. A comparison was made between the newly collected data and the PACES and HGI gravity data to account for any possible relative biases in the data, which could come from datum differences, different reduction equations, or other causes. Six PACES points and twenty HGI points are within 650 ft (200 m) of ADWR points. The PACES and HGI data compared well with the ADWR data. Because of this and because no ADWR points were in exactly the same location as the PACES or HGI points for a direct comparison, no data adjustments were performed.

GPS Data Collection

Each gravity point collected in November 2005 was initially surveyed using a Trimble GPS Pathfinder Pro XRS receiver backpack system. This system utilizes a differential GPS signal from either a differential beacon or a Wide Area Augmentation System (WAAS) enabled satellite. However, the Trimble backpack system did not provide the vertical accuracy required to support the gravity measurements. As a result, these gravity stations were re-surveyed using Post Processed

Kinematic (PPK) GPS. Three points (N075dem, N076dem, and S092dem) were not reoccupied due to access restrictions put in place between November 2005 and February 2006. The elevations used for these points in the gravity processing were taken from the Digital Elevation Model (DEM) at each point location. The point data are in UTM NAD83 Zone 12N, and NAVD88 elevations were calculated using GEOID03.

Trimble 4800 GPS units were used as the PPK base station and rover receivers. The base station was located at the northeast corner of White Hills Rd and US HWY 93 within a well facility (DETTRAN). The position of the PPK base station was established using the National Geodetic Survey's Online Positioning User Service (OPUS). This service uses simultaneous data recorded at the three closest Continuously Operating Reference Stations (CORS) stations and the base station to perform a network adjustment and derive new coordinates for the base station (Table 4). Each new gravity point was surveyed for a minimum of sixty seconds using the rover receivers. These GPS occupations were post-processed using Trimble Geomatics Office v. 1.01, holding the OPUS-derived coordinates fixed for the PPK base station DETTRAN (Table 5).

The gravity/GPS points collected in November 2005 were relocated by using the *Stake To* function of the Trimble 4800 Rover/TSC1 controller with the original GPS surveyed point data and with the gravity point photographs taken during the initial survey. This technique of locating and re-surveying the gravity points resulted in an estimated horizontal error of no greater than one meter and an estimated vertical error of less than 10 cm. Once the gravity points were located, each point was surveyed using the PPK method. During the final day of gravity measurements (02/06/06), stations were surveyed using the PPK survey method (station name prefixes of MAT, PAI and W). It took two days (02/07/06 and 02/08/06) to re-survey the gravity points initially measured on 11/14/05 to 11/16/05 (station name prefixes of N and S).

Gravity Data Collection

Gravity data were collected using ADWR's Scintrex CG-3M Autograv relative gravity meters (gravimeters), numbers 711395 and 411. The gravity measurements were collected in conjunction with GPS measurements. Stations were placed in areas that were relatively flat whenever possible in order to minimize near-zone terrain effects.

A standardized procedure was used at each gravity station. The gravimeter was placed over or directly next to the GPS point and rough level was acquired, the meter was then allowed to stabilize for one minute, during which exact level was established, and finally, a one-minute reading was recorded. At some points, more than one reading was taken due to excessive disturbance to the meter during transportation or to check the stability of the measurement (such as at a base station).

A standard gravity looping procedure was used for gravity data collection. A measurement was taken at a local base station to start and end each day. Secondary base stations were established if necessary to account for instrument drift. The local base stations were tied to an absolute gravity excenter station named Dolan Springs CA located at Mount Tipton School, 16500 Pierce Ferry Rd, Dolan Springs, AZ 86441. The gravity value at Dolan Springs CA is 979,446.531 mGal (Daniel Winester, Geodesist, National Geodetic Survey, written communication).

Gravity Reduction

Gravity data must be corrected for tidal effects and instrument drift, and adjusted to a reference value. The Tide Correction is automatically calculated and applied by the gravimeter using the Longman (1959) formula. Gravity values within a loop are corrected for drift using the following equations:

$$\Delta d / \Delta t = \left(r_{base2} - r_{base1}\right)/\left(t_2 - t_1\right) \quad (1)$$

where $\Delta d/\Delta t$ is the drift rate, t_1 is the time of the first reading (r_{base1}) at the base station and t_2 is the time for the second reading (r_{base2}) at the same base station. The drift-corrected value for each station within the loop is given by:

$$\text{drift-corrected value} = r_{station} - \left(\Delta d / \Delta t\right)\left(t - t_1\right) \quad (2)$$

where $r_{station}$ is the uncorrected gravity value at a station and t is the time of the reading. The drift-corrected value is converted to an observed gravity value (g_{obs}) using the base ties to Dolan Springs CA.

After corrections to the gravity data are made, the data are reduced using standard Bouguer gravity reduction methods (Telford et al., 1990, Sharma, 1997, others). The corrections required are the latitude correction, the free-air correction, the Bouguer correction, and the terrain and curvature corrections.

The normal gravity (g_n) is calculated using the 1967 International Gravity Formula (Sharma, 1997),

$$g_n = 978{,}031.85\left(1 + 0.0053024\sin^2\lambda + 0.0000059\sin^2 2\lambda\right)(\text{mgal}) \quad (3)$$

where λ is the latitude established during the PPK GPS survey.

The Free Air Correction (C_F) is:

$$C_F = 0.3086h\,(\text{mgal}) \quad (4)$$

where h is the elevation in meters established during the PPK GPS survey and with mean seal level as zero elevation.

The Bouguer Correction (C_B) is:

$$C_B = 0.04193\rho h\,(\text{mgal}) \quad (5)$$

using a density (ρ) of 2.67g/cm^3 to represent the average density of crustal rock (granitic

composition).

The three corrections shown above are combined with the observed gravity value to produce the Simple Bouguer Anomaly (SBA):

$$SBA = g_{obs} - g_n + C_F - C_B \quad (6)$$

Terrain Correction and Curvature Correction

Software developed by Cogbill (1998-2002) was used to calculate Terrain Corrections (TCs) and Curvature Corrections (CCs) for each station. The two main programs used in the Geopotential suite were RasterTC and OuterTC (Geophysical Software, 1998-2002).

RasterTC uses a user-defined terrain model to calculate terrain corrections within a few kilometers of a station. A 10-meter terrain model downloaded from seamless.usgs.gov was used. The terrain model is a seamless combination of 10-meter USGS DEMs (NAVD88 vertical datum). RasterTC was used to calculate the terrain correction from an inner radius of 5 m (16.4 ft) to an outer radius of 2 km (1.2 mi).

OuterTC, developed by Plouff (1966) and modified by Cogbill (1998-2002), was used to calculate the rest of the terrain correction from 2 km (1.2 mi) to 166.7 km (103.6 mi) (following Nowell, 1999). A coarser United States topography dataset (30-second grid) was used for OuterTC (usterrain.dat, downloaded from geopotential.com). OuterTC also calculated the Curvature Correction for each gravity station.

A reduction density of 2.67 g/cm^3 (corresponding to crystalline crustal rock) was used for both RasterTC and OuterTC. The Total Terrain Correction (TTC) is the sum of the corrections obtained from each program (RasterTC + OuterTC). The TTC in the study area ranges from 0.347 – 4.297 mgal, with an average of 0.840 mgal.

Both RasterTC and OuterTC use the terrain model elevation at the gravity point to calculate the terrain correction, rather than the measured elevation. The terrain model elevations can differ from actual elevations by up to 7 m (Cogbill, 2000). Using the terrain model rather than the measured elevations eliminates any error in the terrain correction due to stations located on steep hills or in deep holes due to potential errors in the terrain model.

Residual Anomaly

Summing the Simple Bouguer Anomaly with the Terrain Correction and the Curvature Correction gives the Complete Bouguer Anomaly (*CBA*):

$$CBA = SBA + TTC + CC \quad (7)$$

The CBA is a representation of lateral density variations in the subsurface (Figure 3). These density variations could be due to shallow sources (such as alluvial basins, salt or ore deposits, or the presence of different types of rocks) or deep-rooted sources (such as variations in crustal thickness).

Regionally, the CBA dips to the east in the Detrital Valley Ground-water Basin. This variation corresponds to the general thickening of the crust towards the Colorado Plateau from the relatively thin crust of the Basin and Range.

In order to model features such as basins, the regional gravity trend must first be removed (Figure 4). This yields a Residual Anomaly that represents the gravitational field of the near-surface, small-scale features of interest. It is obtained by subtracting the Regional Anomaly from the CBA:

$$\textit{Residual Anomaly} = \textit{CBA} - \textit{Regional Anomaly} \quad (8)$$

The Residual Anomaly (Figure 5) represents the gravity anomaly produced by near-surface geology and is used to model depth-to-bedrock. Minimum curvature with a grid spacing of 3280 ft (1000 m) was used to grid the CBA, Regional Anomaly and the Residual Anomaly.

The best Regional Anomaly is one that accounts for the known geology of an area. The Regional Anomaly was produced by determining CBA values at bedrock points throughout the study area. These points were gridded using Surfer™'s minimum curvature technique to produce the Regional Anomaly (Figure 4). This method has the effect of accounting for both large-scale geologic features such as crustal thickness as well as the density variations of the bedrock in the study area. Different rock types have different densities, such that intrusive igneous and metamorphic rocks have a higher density than volcanic rocks. The Regional Anomaly was only considered for the Detrital Valley Ground-water Basin. The bedrock points that control the Regional Anomaly were chosen to focus the depth-to-bedrock interpretation in the alluvial portion of the Detrital Valley Ground-water Basin.

Gravity Modeling

GM-SYS (Northwest Geophysical Associates, Inc., 2002) was used to model the residual anomaly. GM-SYS is a 2-D gravity modeling program, meaning the models extend to infinity in the ±Y directions (X is the horizontal dimension along the model profile and Z is the vertical dimension). The program allows manipulation of a geologic model to fit the observed gravity data by changing unit thinknesses, shapes and densities.

Thirty-five profiles were modeled through the study area, which start and end on bedrock (Figure 6). The profiles intersect residual minimums and other areas of interest. Most profiles are perpendicular to the residual anomaly trend rather than exactly east-west or north-south across the basin.

For all but one profile, three layers were modeled for the depth-to-bedrock interpretation. The layers included a bedrock layer, an unsaturated alluvial layer and a saturated alluvial layer (Figure 7). The clay unit described later in this report was not modeled as a separate layer because of the lack of information defining its bulk density, and because the density used for the saturated layer is similar to reported average densities for clay (Telford et al., 1990). Profile N11 (Figure 8) intersects Goldfield Consolidated well 06, which encounters a salt body at 773 ft and terminates in salt at 1136 ft. Profile N11 includes a fourth layer to account for the salt.

A density of 2.0 g/cm^3 (density contrast = 0.67 g/cm^3) was used for the unsaturated alluvium and a

density of 2.25 g/cm^3 was used for the saturated alluvium layer (density contrast = 0.42 g/cm^3). The typical density of 2.67 g/cm^3 was used for bedrock. Densities of 2.0 g/cm^3 for unsaturated alluvium and 2.25 g/cm^3 for saturated alluvium both represent a porosity of approximately 0.25 assuming an average clast density of 2.67 g/cm^3. A density of 2.1 g/cm^3 was used for the salt body.

Reynolds (1997) reports the average density of alluvium as 2.0 g/cm^3. This corresponds with two density logs from other basins in Arizona. A density log from TranAm Energy Red Lake Test #1, a well drilled in the Hualapai Valley basin, shows the average density for unsaturated alluviuma as 2.05 g/cm^3. A density log from a well reported in Eaton et al. (1972) west of Phoenix shows the average density for unsaturated alluvium as 2.1 g/cm^3.

If the porosity and the clast density are the same for both the unsaturated and saturated alluvium, then the density of saturated alluvium would be 2.25 g/cm^3. A well log from the Hualapai Valley basin (Southwest Energy Red Lake # 1D) shows the average density of saturated alluvium as 2.25 g/cm^3. Eaton et al. (1972) report an average saturated alluvium density of 2.20 g/cm^3 for a well west of Phoenix.

Telford (1990) reports a range of density values for salt (halite or rock salt) as between 2.1 and 2.6 g/cm^3, with an average density of 2.2 g/cm^3. This is higher than values reported from well logs drilled into salt in the Hualapai Valley basin and into the Luke Salt body west of Phoenix, Arizona. Faulds et al. (1997) report the density of salt from gamma ray logs in the Hualapai Valley basin as 2.06 g/cm^3. However, the salt is interbedded with approximately 5-10% shale and traces of anhydrite, with the shale having an approximate density of 2.24 g/cm^3. Combining the halite and the shale in the reported proportions gives an approximate density for the salt body of 2.1 g/cm^3. Eaton et al. (1972) report a density of 2.1 g g/cm^3 for halite for the Luke Salt body west of Phoenix, and a well drilled in the Hualapai Valley basin (El Paso Red Lake No. 1) shows an average density of 2.1 g/cm^3 for the Hualapai salt body.

The 2-D gravity models were combined to produce a depth-to-bedrock contour map of the study area. The depth-to-bedrock map (Figure 9) was gridded using minimum curvature with a grid spacing of 820 ft (250 m).

The following steps were used to create the depth-to-bedrock map from the residual anomaly:

- Create profiles through the residual anomaly and obtain residual values along each profile.
- Input the residual anomaly into GM-SYS and construct gravity models.
- Convert the profile distance and depth data from GM-SYS into UTM coordinates.
- Grid the UTM profile coordinates with the depth-to-bedrock data.

Well Data

Well log data from over 100 wells were available in the Detrital Valley Ground-water Basin. A selection of those wells is shown in Figure 9. Well logs were from wells drilled for water production and wells drilled for oil and mineral exploration. Well log data were obtained from ADWR's Wells55 database, and additional well data not in that database (most oil and mineral exploration well data) were provided by Stephen M. Richard at the Arizona Geological Survey (AZGS) and the United States Geological Survey (USGS). These included four Phelps Dodge well logs drilled in the Township 30 North, Range 21 West, and eleven Goldfield Consolidated Mining Co. well logs drilled in Township 29 North, Range 21 West. Thirty-one of the available well logs indicated they terminated in bedrock, either granite, volcanics, or unknown bedrock type. Eight of the eleven Goldfield Consolidated wells encountered halite, defining an areal salt extent of approximately four square miles.

Because the locations of the oil and mineral exploration wells were not well constrained, and because of the questionable quality and validity of most of the well logs from ADWR's Wells55 database, the well data were not used to strictly constrain the depth-to-bedrock model. The well data were used in some of the gravity profiles, but the gravity anomaly was given preference over the well log data. The depth-to-bedrock model fits with much of the available well data (Figure 9).

Depth-to-Bedrock Discussion and Results

The depth-to-bedrock model developed in this report is significantly different from Oppenheimer and Sumner's (1980) model (Figure 12). Oppenheimer and Sumner (1980) modeled three profiles in the Detrital Valley, all in the southern third of the basin. The model developed for this report is much shallower in this area. This is because Oppenheimer and Sumner (1980) used a varying-density model, resulting in an assumed density of alluvium in the center of the basin was greater than the value used here. Even though Oppenheimer and Sumner (1980) show bedrock to be deeper, that has a minimal effect on the water storage estimates as they are calculated to a maximum depth of 2000 feet (610 m).

Although Oppenheimer and Sumner (1980) show depth-to-bedrock contours in the northern portion of the Detrital Valley Ground-water Basin, they did not construct any models in the northern and central portions of the basin. The result is a significantly different model of the depth-to-bedrock surface in this area (Figure 12). The maximum depth from the new model is in excess of 3200 ft (975 m) compared to a maximum depth of less than 800 ft (244 m) from Oppenheimer and Sumner (1980).

Gravity modeling does not provide a unique solution to an observed gravity field. Many different geologic conditions can have the same gravity response. To reduce the number of potential models, one must take the known geologic conditions into account. This was done by first choosing a regional anomaly that accounts for both crustal-scale geologic features and smaller-scale density variations, producing a residual gravity anomaly that is the result of the density difference between bedrock and basin fill. The second step is choosing a representative density contrast for the geologic units being modeled. Modeled depth-to-bedrock increases as the density of the alluvium increases,

or the density contrast between the alluvium and the bedrock decreases.

Ground-Water Storage Calculation Methodology

The ground-water storage estimates for the Detrital Valley Ground-water Basin were generated using three surfaces: 1) the land surface, 2) the water-level surface, and 3) the bedrock surface. The three surfaces were defined using an orthogonal grid of nodes (points) with 217 rows and 121 columns that are 0.25 miles (402.25 meters) apart that was overlaid on the Detrital Valley groundwater basin. A land surface elevation, water level elevation, and bedrock elevation was then assigned to each grid node. The elevation data for each node that defined the three surfaces was combined and entered into a spreadsheet that was then used to calculate the estimated volume of ground-water in storage in the basin. The methods used to generate the various surface elevation data, the storage estimates, and the assumptions used in the storage estimates are discussed below.

Land Surface Elevation

The land surface elevation for the Detrital Valley node locations was assigned using data from the U.S. Geological Survey's 30-meter Digital Elevation Models (DEM). DEM data was imported into ArcGIS and a land surface elevation surface was developed using the Surface Spot method. The Detrital Valley node locations were then overlaid onto the land elevation surface and each node location was assigned a land surface elevation.

Water-level Surface Elevation

The Department conducted a water-level sweep of the Detrital Valley groundwater basin in the spring of 2006. The 2006 water-level data points were combined with previously measured water-level data into a set of 85 static water-level measurement data points that were then used to develop a map of the basin's water-level elevation surface. The historic water-level data were deemed appropriate to use in creating a water-level elevation surface because the basin is considered to be in a state of dynamic equilibrium with ground-water discharges equaling long-term natural recharge. Of the 85 static water-level data points only 32 data points were believed to represent basin-fill water-level elevations. The basin-fill water-level data points were imported into the contouring software Surfer™ and an initial set of water level contours was created using the Detrital Valley node grid. The initial water-level elevation contours were edited to produce a set of water-level contours that were deemed to reasonably reflect the current regional ground-water flow system. Figure 13 presents the water-level elevation contour map with selected 2006 water-level data points. A set of X, Y, and Z data points was exported from Surfer™ with the X and Y values corresponding to the Detrital Valley node locations and the Z data representing the water level surface elevation at a node location.

Depth-to-Bedrock Surface

As discussed earlier in this report a depth-to-bedrock surface was developed for the basin. Figure 9 presents the depth-to-bedrock contour map and the location of some gravity survey lines used to model the depth-to-bedrock. The depth-to-bedrock surface was converted to a set of X, Y, and Z data points using Surfer™ for the Detrital Valley node locations as described in the previous section.

Saturated Alluvial Sediments

The extent of the saturated alluvial aquifer was estimated by combining the land surface, depth-to-bedrock and the water-level elevation surface data for each node in the Detrital Valley basin grid. The alluvial sediment thickness for each node was calculated by subtracting the land surface data from the bedrock surface data, and the saturated alluvial thickness at each node was calculated by subtracting the 2006 water level surface data from the bedrock surface data. Nodes with positive saturated alluvial thickness values were used to define the extent of the saturated alluvial aquifer. Figure 1 presents the approximate limit of the saturated alluvial aquifer used in the ground-water storage estimates presented later in this report.

Clay Unit Extent

There is a thick, fine-grained layer that has been observed in well logs in the central portion of the basin. The fine-grained layer consists of clay, gypsum, anhydrite, and salt and is referred to in this report as the clay unit. The clay unit acts as an impediment to ground-water flow and also reduces the amount of recoverable ground water because in well logs it is generally reported to be dry. Well log data were used to estimate the extent of the clay unit in the central part of the Detrital Valley Ground-water Basin. Based on the available well log data the clay unit was assumed to be a tabular body that occupies the central part of the basin. The areal extent of the clay unit and the wells used to define it's extent are presented in Figure 10, and a generalized East-West cross-section through the basin is presented in Figure 11. The clay unit is assumed to generally begin within a mile of the basin margins and is estimated to be about 16 miles north to south and about 3 to 4 miles wide, running from the very northern part of Township 26 North to the northern end of Township 30 North (Figure 10).

The Detrital Valley grid was overlain on a map of the extent of the clay unit and grid nodes that were within the estimated extent of the clay unit were flagged. The available well log data indicates that the clay unit is about 800 feet thick extending from about 600 feet bls to 1,400 feet bls. Therefore, each clay unit grid node was assigned a top and bottom elevation based on an assumed clay unit geometry starting at 600 feet bls and extending to 1,400 feet bls. Few wells fully penetrate the clay unit along the basin margins where the bedrock surface and the assumed clay unit may intersect each other. One well in B-27-20 09add (55-583552, Total Depth: 730 feet) penetrates about 250 feet of the clay unit and then bottoms out in 40 feet of a volcanic conglomerate. Another well in B-27-20 09ccd (55-594399, Total Depth: 1365 feet) goes directly from the clay unit into a weathered, fractured granite. Several exploration wells located in the northern part of the basin also report alluvial material underlying the clay before penetrating bedrock. So for the purposes of the storage calculations it was decided to arbitrarily assign a uniform aquifer thickness of 50 feet to all nodes where the assumed clay unit bottom elevation intersected the modeled bedrock surface. This insures some saturated alluvial material occurs below the clay layer, which is consistent with some of the observed well data.

Storage Calculations

The node locations with data that defined the tops and bottoms of various surfaces were used to calculate the volume of ground water in storage for the saturated alluvial portion Detrital Valley Ground-water Basin. The Senator Valley area was not included in these estimates. Figure 1 shows the extent of the saturated alluvial material where ground water in storage was calculated. The node locations can be considered as the center point of a cube that is 1,320 feet (402.25 meters) on a side. The volume of saturated aquifer material for each cube can be calculated using the saturated thickness of each cube.

The volume of saturated aquifer material (Ft^3) was calculated by multiplying the cube area (Ft^2) times the saturated thickness above the AWS depth limit (Ft). The saturated aquifer material volume was converted into ground-water in storage (acre-feet) using a conversion of cubic feet to acre-feet times the estimated specific yield values. Assumptions used in the storage calculations are:

- The saturated alluvial material extends from the water-level elevation to the depth limit or to bedrock, whichever is encountered first. If the clay unit is encountered, then for the 1,200 foot depth limit, the altitude of the clay top becomes the aquifer bottom. This assumes that the 1,200 foot depth limit occurs within the clay unit (see Figure 11). Wells completed above or in the clay unit generally report at least several hundred feet of saturated aquifer above the clay unit.

- The saturated thickness to 1,500 and 2,000 feet below land surface for cubes that contain the clay unit was calculated as the saturated thickness above the clay top plus the saturated thickness beneath the clay unit to the depth limit or bedrock, whichever occurs first.

- If the modeled bedrock elevation is above the assumed clay bottom elevation then the clay bottom elevation was moved up to 50 feet above the bedrock elevation. This guarantees at least 50 feet of saturated aquifer material underneath the clay unit. The groundwater storage calculated for the cubes that were assigned the 50 foot thickness was only 3 percent of the total storage, which was deemed to not significantly affect the total estimated volume of ground-water in storage.

Ground-Water Storage Discussion and Results

The total estimated ground-water in storage for the Detrital Valley Ground-water Basin is presented in Table 1 and the estimated amount of ground-water in storage by township is presented in Table 2. Estimating the amount of ground water in storage in the Detrital Valley Ground-water Basin is complicated by the presence of the clay unit discussed earlier in this report. The clay unit reduces the amount of recoverable ground water because it is generally reported as dry in well logs.

The ground water in storage estimates are presented with a range of specific yield values from 3 to 8 percent. The specific yield values reflect a possible range of average specific yields found in the geologic units described in well logs from the area. The range of specific yield values is slightly lower than estimated regional specific yield values used by other investigators for northwestern Arizona (Gillespie and Bentley, 1971). The lower specific yield values were used in Tables 1 and 2 to present a conservative estimate of the volume of ground water in storage. In the future, as more data regarding specific yield values and the areal extent of the clay unit becomes available, the ground water in storage estimates will be revised.

Table 1. Estimated volume of recoverable ground water for Detrital Valley Ground-water Basin

Specific Yield	To 1,200 feet bls	To 1,500 feet bls	To 2,000 feet bls
3%	1,480,000	1,850,000	2,460,000
6%	2,950,000	3,700,000	4,920,000
8%	3,940,000	4,930,000	6,550,000

Notes:

1. All values are in acre-feet and rounded to the nearest 10,000 acre-feet

The values in column 2 (to 1,200 feet bls) of Table 1 are the estimated volume of ground water in storage in the AWS Program depth limit of 1,200 feet bls or bedrock, whichever occur first, in the alluvial portion of the Detrital Valley Ground-water Basin. The estimated storage to a depth of 1,200 feet bls ranges from about 1.48 million acre-feet to about 3.94 million acre-feet and includes the assumed extent of the clay unit.

Table 1 also presents estimates of ground water in storage to a depth of 1,500 and 2,000 feet bls or bedrock, whichever occurs first (columns 3 and 4). If the depth limit for ground-water withdrawals is lowered to 1,500 feet bls the estimated amount of ground water in storage increases by an additional 400,000 to 1 million acre-feet. The amount of ground water in storage available to 1,500 feet bls ranges from about 1.85 to 4.93 million acre-feet, depending on the assumed specific yield value. If the depth limit is set at 2,000 feet bls, the available amount of ground water in storage ranges from about 2.46 to 6.55 million acre-feet.

Caution should be exercised when utilizing the estimates in Tables 1 and 2 for proving physical availability for water supply calculations. Not all of the estimated ground water may be available for withdrawal from wells due to the location of future production wells, localized variations in the saturated thickness of the regional aquifer, and other localized hydrogeologic conditions.

Table 2a. Potential recoverable ground water by township in the Detrital Valley Ground-water Basin at 3 percent specific yield.

Township	Volume in Storage to 1,200 feet bls	Volume in Storage to 1,500 feet bls	Volume in Storage to 2,000 feet bls
T24N, R19W	53,850	89,825	119,980
T24N, R20W	35,820	52,275	66,235
T25N, R19W	62,500	90,375	121,760
T25N, R20W	193,960	273,175	375,260
T26N, R20W	157,010	202,135	246,270
T26N, R21W	30,920	43,575	66,600
T27N, R20W	37,260	59,380	137,970
T27N, R21W	70,580	93,935	170,600
T28N, R20W	20,675	28,635	48,250
T28N, R21W	238,925	280,475	367,640
T29N, R20W	29,810	29,810	29,810
T29N, R21W	312,545	362,940	464,135
T30N, R20W	18,700	18,850	18,850
T30N, R21W	75,285	80,565	80,565
T31N, R20W	11,625	11,625	11,625
T31N, R21W	126,975	132,580	132,600

All values are in acre-feet

Table 2b. Potential recoverable ground water by township in the Detrital Valley Ground-water Basin at 6 percent specific yield.

Township	Volume in Storage to 1,200 feet bls	Volume in Storage to 1,500 feet bls	Volume in Storage to 2,000 feet bls
T24N, R19W	107,700	179,650	239,960
T24N, R20W	71,640	104,550	132,470
T25N, R19W	125,000	180,750	243,520
T25N, R20W	387,920	546,350	750,520
T26N, R20W	314,020	404,270	492,540
T26N, R21W	61,840	87,150	133,200
T27N, R20W	74,520	118,760	275,940
T27N, R21W	141,160	187,870	341,200
T28N, R20W	41,350	57,270	96,500
T28N, R21W	477,850	560,950	735,280
T29N, R20W	59,620	59,620	59,620
T29N, R21W	625,090	725,880	928,270
T30N, R20W	37,400	37,700	37,700
T30N, R21W	150,570	161,130	161,130
T31N, R20W	23,250	23,250	23,250
T31N, R21W	253,950	265,160	265,200

All values are in acre-feet

Table 2c. Potential recoverable ground water by township in the Detrital Valley Ground-water Basin at 8 percent specific yield.

Township	Volume in Storage to 1,200 feet bls	Volume in Storage to 1,500 feet bls	Volume in Storage to 2,000 feet bls
T24N, R19W	143,595	239,520	319,935
T24N, R20W	95,515	139,405	176,620
T25N, R19W	166,655	240,985	324,680
T25N, R20W	517,230	728,460	1,000,700
T26N, R20W	418,690	539,025	656,715
T26N, R21W	82,455	116,195	177,600
T27N, R20W	99,360	158,350	367,920
T27N, R21W	188,210	250,490	454,925
T28N, R20W	55,130	76,360	128,665
T28N, R21W	637,140	747,940	980,375
T29N, R20W	79,490	79,490	79,490
T29N, R21W	833,445	967,830	1,237,680
T30N, R20W	49,860	50,260	50,260
T30N, R21W	200,770	214,850	214,850
T31N, R20W	31,000	31,000	31,000
T31N, R21W	338,590	353,530	353,580

All values are in acre-feet

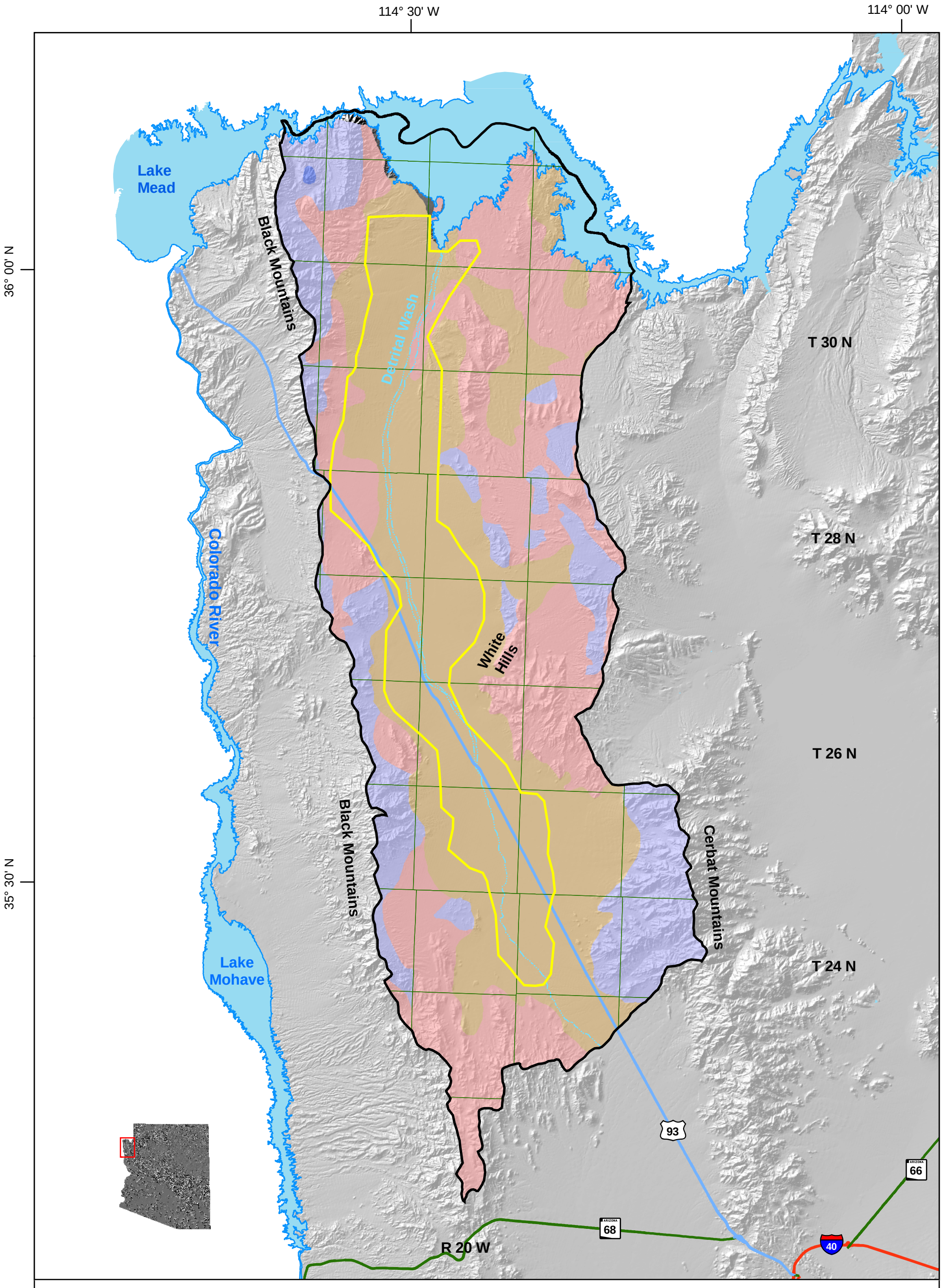

FIGURE 1.
DETRITAL VALLEY GROUND-WATER BASIN
Basin Overview With Generalized Geology

114° 30' W

114° 00' W

36° 00' N

35° 30' N

T 30 N

T 28 N

T 26 N

T 24 N

R 20 W

FIGURE 2.
DETRITAL VALLEY GROUND-WATER BASIN
Gravity Points Used For Modeling

ADWR Gravity Points
UTEP PACES Gravity Points
HydroGEOPHYSICS, Inc. Gravity Points
Township
Rivers
Lakes
Detrital Valley Ground-water Basin

N
W E
S

1:335,232

0 1.5 3 6 9 12 Miles

© ARIZONA DEPARTMENT OF WATER RESOURCES

114° 30' W

114° 00' W

36° 00' N

35° 30' N

T 30 N

T 28 N

T 26 N

T 24 N

R 20 W

FIGURE 3.
DETRITAL VALLEY GROUND-WATER BASIN
Complete Bouger Anomaly
Contour Interval = 2mGals

CBA Contours
High : -68.1 mGals
Low : -148.3 mGals
HardRock
Detrital Valley Ground-water Basin

1:335,232

0 1.5 3 6 9 12 Miles

© ARIZONA DEPARTMENT OF WATER RESOURCES

114° 30' W

114° 00' W

36° 00' N

35° 30' N

T 30 N

T 28 N

T 26 N

T 24 N

R 20 W

FIGURE 4.
DETRITAL VALLEY GROUND-WATER BASIN
Regional Anomaly
Contour Interval = 2mGals

Regional Anomaly Contours
High : -74.3 mGals
Low : -138.5 mGals
HardRock
Detrital Valley Ground-water Basin

1:335,232

0 1.5 3 6 9 12 Miles

ARIZONA DEPARTMENT OF WATER RESOURCES

114° 30' W

114° 00' W

36° 00' N

35° 30' N

T 30 N

T 28 N

T 26 N

T 24 N

R 20 W

FIGURE 5.
DETRITAL VALLEY GROUND-WATER BASIN
Residuall Anomaly
Contour Interval = 2mGals

Residual Anomaly Contours
High : 21.3 mGals
Low : -20.9 mGals
HardRock
Detrital Valley Ground-water Basin

1:335,232

0 1.5 3 6 9 12 Miles

N W E S

© ARIZONA DEPARTMENT OF WATER RESOURCES

114° 30' W

114° 00' W

36° 00' N

35° 30' N

N17
N16
N12
N11
N09
N10
N08
N18
N07
N06
N14
N05
N15
N04
N19
N03
N02
N01
S15
S16
S14
S13
S12
S11
S09
S10
S08
S06
S17
S07
S05
S04
S03
S02
S01
S19
S20

T 30 N

T 28 N

T 26 N

T 24 N

R 20 W

FIGURE 6.
DETRITAL VALLEY GROUND-WATER BASIN
GMSYS Modeling Profiles

GMSYS Profiles
Township
Rivers
Lakes
Detrital Valley Ground-water Basin

N
W
E
S

1:335,232

0 1.5 3 6 9 12 Miles

© ARIZONA DEPARTMENT OF WATER RESOURCES

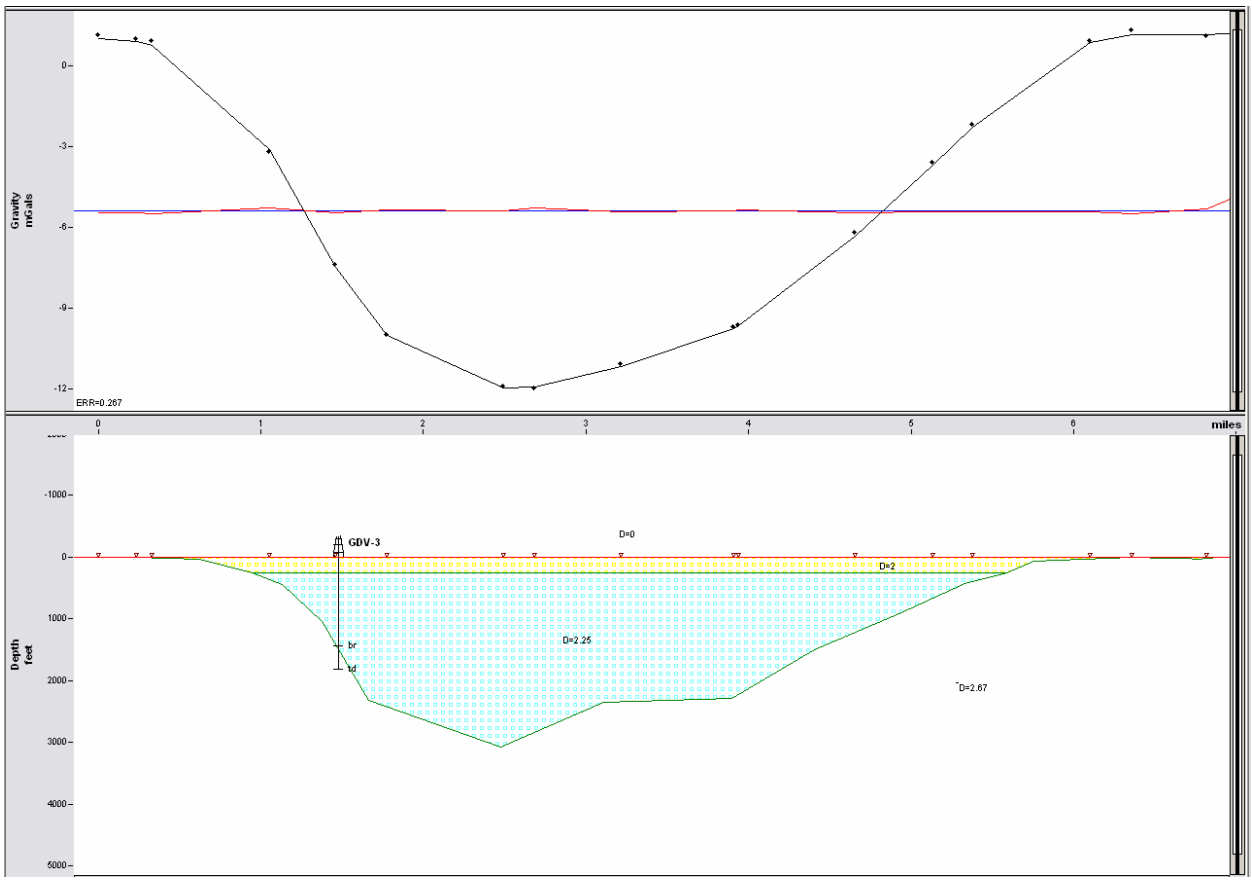

Figure 7. GM-SYS model of profile N18 (see Figure 6) with a vertical exaggeration of 2. The top frame is the residual anomaly profile (dots) with the model's fit (black line) to the anomaly. The red line shows the error in fit between the gravity data and the model, and the blue line represents zero error. The vertical axis is the residual gravity value in mgals. The bottom frame shows the bedrock model. Each color represents a different density of the alluvial fill. Yellow represents a density of 2.0 g/cm^3 (unsaturated alluvium) and blue represents a density of 2.25 g/cm^3 (saturated alluvium). The vertical axis in the bottom frame is depth in feet, and the horizontal axis for both frames is distance in miles. The well GDV-3 hits bedrock at 1440 ft, with a total depth of 1820 ft. While this well was not used as control for the model, it corresponds very well with the interpreted depth-to-bedrock model.

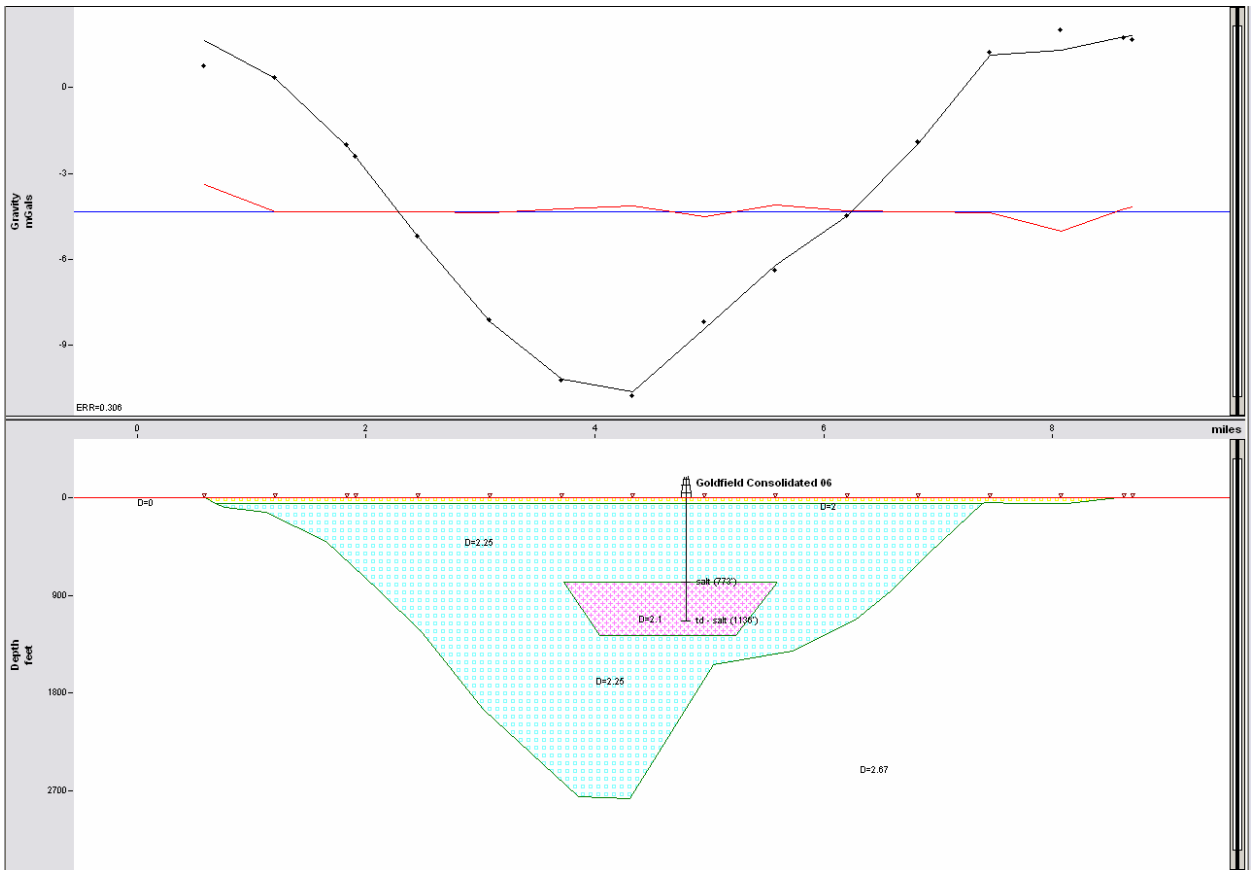

Figure 8. GM-SYS model of profile N11 (see Figure 6) with a vertical exaggeration of 5. The top frame is the residual anomaly profile (dots) with the model's fit (black line) to the anomaly. The red line shows the error in fit between the gravity data and the model, and the blue line represents zero error. The vertical axis is the residual gravity value in mgals. The bottom frame shows the bedrock model. Each color represents a different density of the alluvial fill. Yellow represents a density of 2.0 g/cm^3 (unsaturated alluvium), blue represents a density of 2.25 g/cm^3 (saturated alluvium) and purple represents a density of 2.1 g/cm^3 (halite). The vertical axis in the bottom frame is depth in feet, and the horizontal axis for both frames is distance in miles. Goldfield Consolidated Mining Co. well number 06 encounters salt at 773 ft (236 m) and terminates in salt at 1136 ft (346 m). The extent of the salt was determined from other Goldfield Consolidated Mining Co. wells in Township 29 N Range 21 W, which indicate an extent of the salt body of approximately 4 square miles (2 miles by 2 miles). No wells penetrated the entire thickness of the salt, so the depth of the salt was interpreted by the gravity model. The shape of the salt was chosen to roughly follow the shape of the basin.

114° 30' W

114° 00' W

36° 00' N

35° 30' N

T 30 N

T 28 N

T 26 N

T 24 N

R 20 W

FIGURE 9.
DETRITAL VALLEY GROUND-WATER BASIN
Depth To Bedrock
Contour Interval = 400 Feet

Depth To Bedrock Contours (Feet)
Wells That Did Not Encounter Bedrock (Total Well Depth)
Wells That Did Encounter Bedrock (Depth At Bedrock)
Township
Rivers
Lakes
Detrital Valley Ground-water Basin

N
W E
S

1:335,232

0 1.5 3 6 9 12 Miles

© ARIZONA DEPARTMENT OF WATER RESOURCES

114° 30' W

114° 00' W

36° 00' N

35° 30' N

T 30 N

T 28 N

T 26 N

T 24 N

R 20 W

A

A'

FIGURE 10.
DETRITAL VALLEY GROUND-WATER BASIN
Estimated Extent of Clay Layer

Wells Used to Define Clay Extent
Clay Extent
Township
Rivers
Lakes
Detrital Valley Ground-water Basin

N
W E
S

1:335,232

0 1.5 3 6 9 12 Miles

© ARIZONA DEPARTMENT OF WATER RESOURCES

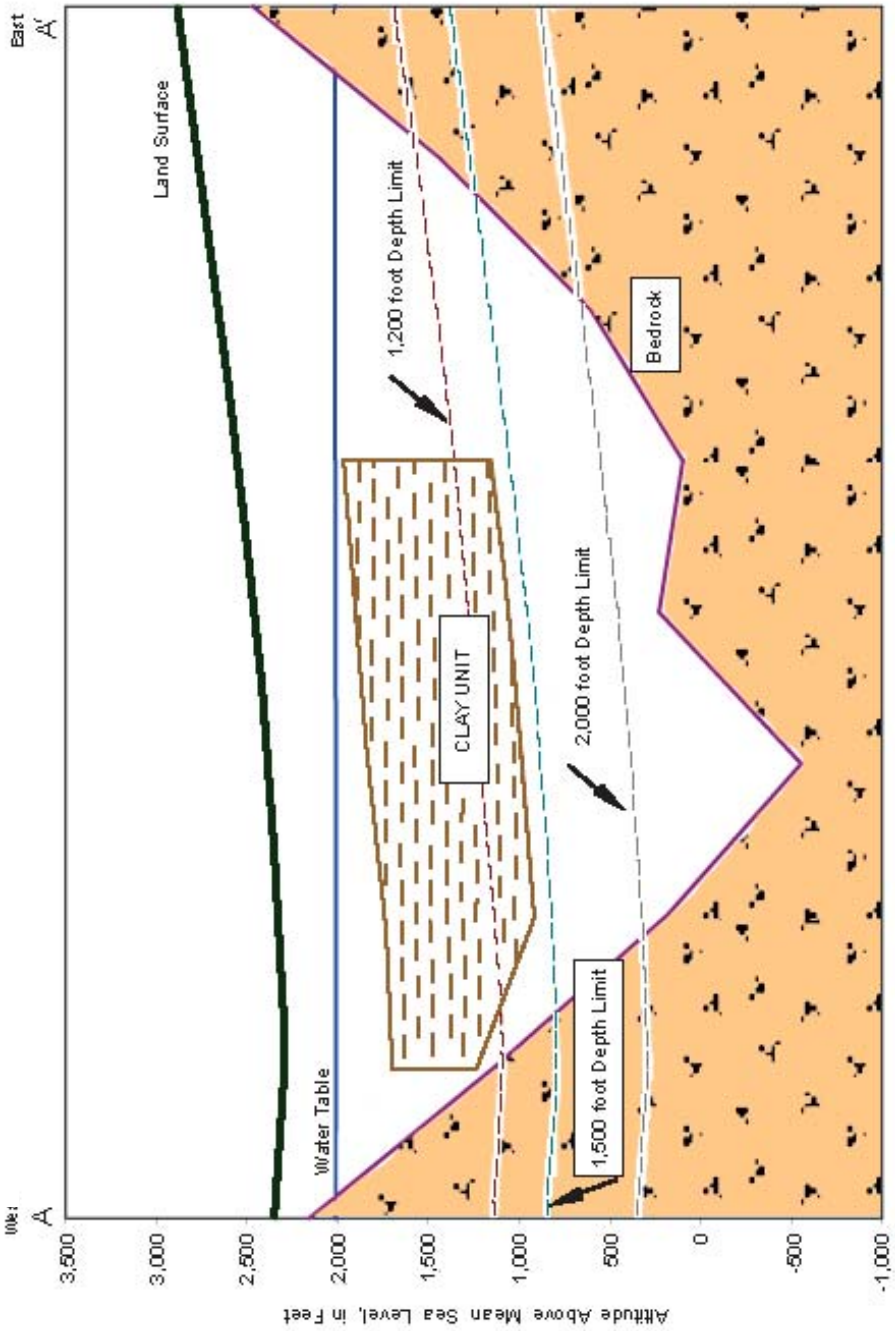

Figure 11. Generalized cross-section through the Detrital Valley Ground-water Basin.

114° 30' W
114° 00' W
36° 00' N
35° 30' N

T 30 N
T 28 N
T 26 N
T 24 N
R 20 W

Depth To Bedrock Contours (Feet)
Township
Rivers
Lakes
Detrital Valley Ground-water Basin

1:530,214
0 1.5 3 6 9 12 Miles

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FIGURE 12.
DETRITAL VALLEY GROUND-WATER BASIN
Depth To Bedrock Model Comparison

ADWR Depth To Bedrock Model

Oppenheimer and Sumner Depth To Bedrock Model

114° 30' W

114° 00' W

36° 00' N

35° 30' N

T 30 N

T 28 N

T 26 N

T 24 N

R 20 W

1284

1992

2013

2016

2014

2010

2009

2019

2022

2016

2024

2011

2041

2078

2218

2224

2218

2221

2231

2222

2228

2235

2231

2240

2231

2232

2231

2234

2230

2231

1250

1300

1400

1450

1500

1550

1600

1650

1700

1750

1800

1850

1900

1928

1943

1975

2000

2050

2100

2150

2200

2225

FIGURE 13.
DETRITAL VALLEY GROUND-WATER BASIN
Water Level Elevation Map
Contour Interval = 25 Feet

Well (Water Level Elevation in Feel ASL)
Depth To Water Contour
Township
Rivers
Lakes
Detrital Valley Ground-water Basin

N
W E
S

1:335,232

0 1.5 3 6 9 12 Miles

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Appendix A

NGS Datasheets

Table 3. NGS Data Sheet for H119.

See file dsdata.txt for more information about the datasheet.

```
DATABASE = Sybase ,PROGRAM = datasheet, VERSION = 7.42
1        National Geodetic Survey,   Retrieval Date = OCTOBER 11, 2006
 FS0400
***********************************************************************
 FS0400  DESIGNATION -  H 119
 FS0400  PID         -  FS0400
 FS0400  STATE/COUNTY-  AZ/MOHAVE
 FS0400  USGS QUAD   -  SENATOR MOUNTAIN SW (1989)
 FS0400
 FS0400                         *CURRENT SURVEY CONTROL
 FS0400  ______________________________________________________________________
 FS0400* NAD 83(1986)-  35 49 31.     (N)    114 29 40.     (W)     SCALED
 FS0400* NAVD 88     -       659.009  (meters)    2162.10   (feet)  POSTED
 FS0400  ______________________________________________________________________
 FS0400  GEOID HEIGHT-         -28.20  (meters)                     GEOID03
 FS0400  DYNAMIC HT  -         658.320 (meters)    2159.84  (feet)  COMP
 FS0400  MODELED GRAV-     979,566.9   (mgal)                       NAVD 88
 FS0400
 FS0400  VERT ORDER  -  * POSTED, Code A , SEE BELOW
 FS0400
 FS0400.The horizontal coordinates were scaled from a topographic map and have
 FS0400.an estimated accuracy of +/- 6 seconds.
 FS0400
 FS0400.The orthometric height was determined by differential leveling
 FS0400.and adjusted by the National Geodetic Survey in 1992..
 FS0400.* This is a POSTED BENCH MARK height.  Code A indicates a distribution
 FS0400.rate of 0.0 thru 1.0 mm/km.
 FS0400
 FS0400.The geoid height was determined by GEOID03.
 FS0400
 FS0400.The dynamic height is computed by dividing the NAVD 88
 FS0400.geopotential number by the normal gravity value computed on the
 FS0400.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 FS0400.degrees latitude (g = 980.6199 gals.).
 FS0400
 FS0400.The modeled gravity was interpolated from observed gravity values.
 FS0400
 FS0400;                    North         East     Units  Estimated Accuracy
 FS0400;SPC AZ W     -   535,400.      146,090.    MT  (+/- 180 meters Scaled)
 FS0400
 FS0400                          SUPERSEDED SURVEY CONTROL
 FS0400
 FS0400  NGVD 29 (??/??/92)  658.269  (m)         2159.67  (f) ADJ UNCH    1 1
 FS0400
 FS0400.Superseded values are not recommended for survey control.
 FS0400.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 FS0400.See file dsdata.txt to determine how the superseded data were derived.
 FS0400
 FS0400_U.S. NATIONAL GRID SPATIAL ADDRESS: 11SQV263674(NAD 83)
 FS0400_MARKER: DB = BENCH MARK DISK
 FS0400_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
 FS0400_SP_SET: SET IN TOP OF CONCRETE MONUMENT
 FS0400_STAMPING: H 119 1935
 FS0400_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
 FS0400+STABILITY: SURFACE MOTION
```

```
FS0400
FS0400  HISTORY     - Date     Condition        Report By
FS0400  HISTORY     - 1935     MONUMENTED       CGS
FS0400  HISTORY     - 1950     GOOD             NGS
FS0400  HISTORY     - 1963     GOOD             NGS
FS0400
FS0400                          STATION DESCRIPTION
FS0400
FS0400'DESCRIBED BY NATIONAL GEODETIC SURVEY 1950
FS0400'18.6 MI S FROM MOUTH OF DETRITAL WASH.
FS0400'6.9 MILES SOUTH ALONG DETRITAL WASH FROM THE SOUTH SHORE OF LAKE
FS0400'MEAD, THENCE 11.7 MILES SOUTH ALONG AN ABANDONED ROAD, 38 FEET
FS0400'EAST OF THE CENTER LINE OF THE ROAD, 18 FEET WEST OF A DOUBLE
FS0400'12-INCH YUCCA TREE, 2.7 FEET SOUTH OF A WITNESS POST, ABOUT 2
FS0400'FEET HIGHER THAN THE ROAD, AND SET IN THE TOP OF A CONCRETE POST
FS0400'PROJECTING 0.7 FOOT ABOVE THE GROUND.
FS0400
FS0400                          STATION RECOVERY (1963)
FS0400
FS0400'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1963
FS0400'RECOVERED IN GOOD CONDITION.

*** retrieval complete.
Elapsed Time = 00:00:01
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Appendix B

NGS OPUS Results

Table 4. NGS OPUS results for DETTRAN for February 7, 2006 and February 8, 2006.

FILE: 79540380.DAT 000007438

NGS OPUS SOLUTION REPORT
==========

USER: ADWR DATE PROCESSED: February 21, 2006
RINEX FILE: 7954038o.06o TIME PROCESSED: 16:58:24 UTC

SOFTWARE: page5 0601.10 master29.pl START: 2006/02/07 14:53:00
EPHEMERIS: igs13612.eph [precise] STOP: 2006/02/08 01:20:00
NAV FILE: brdc0380.06n OBS USED: 23349 / 24767 : 94%
ANT NAME: TRM4800 NONE # FIXED AMB: 115 / 115 : 100%
ARP HEIGHT: 1.998 OVERALL RMS: 0.015(m)

REF FRAME: NAD_83(CORS96)(EPOCH:2002.0000) ITRF00 (EPOCH:2006.1037)

X:	-2148502.191(m)	0.011(m)	-2148502.905(m)	0.011(m)
Y:	-4719919.939(m)	0.047(m)	-4719918.622(m)	0.047(m)
Z:	3701846.385(m)	0.024(m)	3701846.327(m)	0.024(m)
LAT:	35 42 8.78149	0.014(m)	35 42 8.79706	0.014(m)
E LON:	245 31 30.09301	0.010(m)	245 31 30.04546	0.010(m)
W LON:	114 28 29.90699	0.010(m)	114 28 29.95454	0.010(m)
EL HGT:	712.269(m)	0.052(m)	711.502(m)	0.052(m)
ORTHO HGT:	740.634(m)	0.058(m)	[Geoid03 NAVD88]	

	UTM COORDINATES UTM (Zone 11)	STATE PLANE COORDINATES SPC (0203 AZ W)
Northing (Y) [meters]	3953884.218	521759.591
Easting (X) [meters]	728450.198	147752.792
Convergence [degrees]	1.47418166	-0.42309245
Point Scale	1.00024316	0.99998635
Combined Factor	1.00013135	0.99987457

US NATIONAL GRID DESIGNATOR: 11SQV2845053884(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DG4265	NVTR TROPICANA CORS ARP	N360557.001	W1151944.433	88790.5
AJ1826	LVWD LAS VEGAS VALLEY CORS ARP	N360934.026	W1151128.797	82169.0
AM7015	KING KINGMAN CORS ARP	N351150.480	W1140229.275	68488.6

NEAREST NGS PUBLISHED CONTROL POINT

FS0285	1416+40	N354212.	W1142839.	249.1

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

FILE: 79540392.DAT 000007440

NGS OPUS SOLUTION REPORT
==========

USER: ADWR DATE PROCESSED: February 21, 2006
RINEX FILE: 7954039o.06o TIME PROCESSED: 16:51:46 UTC

SOFTWARE: page5 0601.10 master4.pl START: 2006/02/08 14:34:00
EPHEMERIS: igs13613.eph [precise] STOP: 2006/02/08 22:08:00
NAV FILE: brdc0390.06n OBS USED: 16809 / 17702 : 95%
ANT NAME: TRM4800 NONE # FIXED AMB: 87 / 87 : 100%
ARP HEIGHT: 1.998 OVERALL RMS: 0.015(m)

REF FRAME: NAD_83(CORS96)(EPOCH:2002.0000) ITRF00 (EPOCH:2006.1062)

X:	-2148502.188(m)	0.009(m)	-2148502.902(m)	0.009(m)
Y:	-4719919.932(m)	0.037(m)	-4719918.615(m)	0.037(m)
Z:	3701846.384(m)	0.014(m)	3701846.326(m)	0.014(m)

LAT:	35 42 8.78161	0.013(m)	35 42 8.79717	0.013(m)
E LON:	245 31 30.09301	0.011(m)	245 31 30.04546	0.011(m)
W LON:	114 28 29.90699	0.011(m)	114 28 29.95454	0.011(m)
EL HGT:	712.262(m)	0.036(m)	711.495(m)	0.036(m)
ORTHO HGT:	740.627(m)	0.044(m)	[Geoid03 NAVD88]	

	UTM COORDINATES (UTM (Zone 11))	STATE PLANE COORDINATES (SPC (0203 AZ W))
Northing (Y) [meters]	3953884.221	521759.595
Easting (X) [meters]	728450.198	147752.792
Convergence [degrees]	1.47418166	-0.42309246
Point Scale	1.00024316	0.99998635
Combined Factor	1.00013135	0.99987458

US NATIONAL GRID DESIGNATOR: 11SQV2845053884(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DG4265	NVTR TROPICANA CORS ARP	N360557.001	W1151944.433	88790.5
AJ1826	LVWD LAS VEGAS VALLEY CORS ARP	N360934.026	W1151128.797	82169.0
AM7015	KING KINGMAN CORS ARP	N351150.480	W1140229.275	68488.6

NEAREST NGS PUBLISHED CONTROL POINT

FS0285	1416+40	N354212.	W1142839.	249.1

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

Appendix C

GPS Results

Table 5. GPS results. UTM North and UTM East are UTM NAD83 Zone 12N. H119 (in red) is an NGS monument (datasheet in Table 3). Elevations were calculated from the WGS84 height using GEOID03, and are NAVD88.

Name	Latitude NAD83	Longitude NAD83	UTM North (m)	UTM East (m)	Height WGS84(m)	Elevation GEOID03 (m)
BASE2	35°32'05.53298"N	114°21'18.62142"W	3937541.132	195783.704	872.567	901.048
CURVE	35°41'18.46696"N	114°28'11.72071"W	3954946.579	185976.970	723.102	751.485
DETTRAN	35°42'08.78163"N	114°28'29.90704"W	3956513.783	185574.567	712.267	740.632
DOLAN CA	35°36'12.78872"N	114°15'20.69474"W	3944859.730	205053.971	1071.220	1099.159
H119	35°49'32.24899"N	114°29'38.97335"W	3970246.125	184325.821	630.857	659.062
MAT126	35°39'26.99889"N	114°26'50.82062"W	3951438.740	187890.754	746.619	775.017
MAT132	35°38'13.63655"N	114°25'50.84077"W	3949124.435	189320.707	766.673	795.077
MAT133	35°38'51.97926"N	114°25'19.23212"W	3950278.622	190157.298	762.259	790.632
MAT135	35°38'26.38154"N	114°24'17.44176"W	3949435.518	191684.630	782.813	811.164
MAT136	35°37'56.64622"N	114°23'41.01132"W	3948487.186	192569.644	796.972	825.317
MAT137	35°37'29.36730"N	114°22'57.73730"W	3947608.744	193629.697	817.455	845.786
MAT141	35°37'26.14057"N	114°25'20.10986"W	3947633.369	190043.020	781.436	809.845
MAT142	35°36'38.78961"N	114°24'40.25685"W	3946138.878	190995.383	789.997	818.413
MAT169	35°33'39.76721"N	114°22'28.92970"W	3940506.414	194111.813	836.119	864.589
MAT171	35°36'49.15456"N	114°22'05.79314"W	3946324.276	194894.520	851.143	879.462
MAT172	35°36'41.41290"N	114°20'10.31631"W	3945986.499	197793.081	908.416	936.633
MAT173	35°35'23.19256"N	114°19'38.84455"W	3943548.546	198503.666	895.066	923.319
MAT174	35°37'25.66232"N	114°20'05.39564"W	3947346.264	197963.228	954.714	982.888
N001	35°32'05.53946"N	114°21'18.63066"W	3937541.340	195783.478	872.584	901.065
N002	35°42'01.14204"N	114°28'27.83798"W	3956276.439	185618.248	715.709	744.078
N003	35°48'32.39267"N	114°32'31.90571"W	3968557.150	179917.433	678.423	706.678
N004	35°50'15.22996"N	114°32'18.04379"W	3971714.750	180380.252	623.325	651.551
N005	35°53'14.56421"N	114°31'01.26487"W	3977173.566	182506.596	548.172	576.326
N006	35°55'51.71408"N	114°29'57.86222"W	3981960.899	184270.856	493.530	521.625
N007	35°55'39.61143"N	114°28'55.58412"W	3981531.917	185818.960	499.757	527.850
N008	35°58'08.79351"N	114°30'25.25938"W	3986211.382	183736.001	494.878	522.923
N009	35°58'42.87189"N	114°31'57.05045"W	3987345.045	181473.816	611.719	639.717
N010	35°59'03.25350"N	114°32'56.81010"W	3988027.803	179999.306	693.219	721.181
N011	36°01'20.24656"N	114°31'05.27847"W	3992149.593	182946.390	537.299	565.291
N012	36°02'36.29176"N	114°31'07.99963"W	3994496.364	182963.047	507.652	535.635
N013	36°03'48.72251"N	114°29'22.66301"W	3996634.204	185680.416	406.782	434.791
N014	36°03'44.09212"N	114°28'22.23364"W	3996437.294	187187.841	337.036	365.053
N015	36°03'52.01936"N	114°30'02.82838"W	3996771.986	184678.747	421.559	449.558
N016	36°04'29.25366"N	114°29'36.57721"W	3997896.194	185377.058	379.911	407.909
N017	36°03'40.21322"N	114°31'35.54140"W	3996491.909	182344.972	521.323	549.289
N018	36°03'51.51187"N	114°32'36.04076"W	3996895.293	180843.320	580.354	608.291
N019	36°03'38.20313"N	114°33'37.99339"W	3996541.672	179277.619	659.293	687.201

Name	Latitude NAD83	Longitude NAD83	UTM North (m)	UTM East (m)	Height WGS84(m)	Elevation GEOID03 (m)
N020	36°03'48.33335"N	114°34'21.71152"W	3996894.122	178194.777	720.951	748.843
N021	36°04'19.76885"N	114°34'42.19520"W	3997882.093	177717.742	779.691	807.582
N022	35°42'15.07536"N	114°27'42.04204"W	3956665.226	186784.932	715.451	743.798
N023	35°42'26.30759"N	114°27'12.89783"W	3956985.633	187529.909	723.703	752.031
N024	35°42'46.72958"N	114°26'09.21773"W	3957558.910	189153.030	742.209	770.489
N025	35°43'30.77420"N	114°24'11.41181"W	3958813.309	192161.832	805.484	833.645
N026	35°43'52.87128"N	114°21'46.27933"W	3959368.538	195833.261	950.803	978.828
N027	35°43'54.52289"N	114°20'17.35492"W	3959343.036	198070.007	1044.103	1072.052
N028	35°44'14.89527"N	114°18'02.82246"W	3959856.476	201472.424	1171.413	1199.238
N029	35°44'57.10389"N	114°18'41.45738"W	3961190.307	200545.445	1177.989	1205.826
N030	35°44'57.52935"N	114°19'38.00037"W	3961251.567	199125.081	1111.797	1139.682
N031	35°43'13.16673"N	114°18'34.34922"W	3957980.438	200615.855	1119.617	1147.497
N032	35°42'23.63951"N	114°19'38.25204"W	3956508.148	198957.715	1031.977	1059.934
N033	35°41'44.57795"N	114°19'08.12691"W	3955278.421	199674.357	1059.813	1087.761
N034	35°43'12.46438"N	114°20'42.70291"W	3958068.305	197388.672	1006.940	1034.930
N035	35°42'23.74087"N	114°20'43.30802"W	3956566.922	197322.214	982.504	1010.518
N036	35°42'23.19005"N	114°21'32.53003"W	3956592.249	196084.108	953.042	981.101
N037	35°44'57.71878"N	114°21'45.13345"W	3961366.491	195930.665	993.071	1021.062
N039	35°53'24.80640"N	114°32'40.99943"W	3977579.805	180016.121	625.057	653.196
N040	35°53'31.32978"N	114°34'00.45330"W	3977853.514	178030.345	703.723	731.846
N041	35°53'35.57573"N	114°35'05.24180"W	3978043.950	176409.939	807.425	835.555
N042	36°00'31.83466"N	114°29'07.20939"W	3990550.770	185849.737	442.016	470.057
N043	36°02'15.97048"N	114°27'40.50196"W	3993683.489	188135.687	345.733	373.769
N044	36°01'36.06690"N	114°27'59.88817"W	3992470.656	187606.466	362.978	391.020
N045	36°00'59.72084"N	114°27'23.34375"W	3991317.653	188481.783	418.592	446.637
N046	36°00'41.31176"N	114°26'17.02570"W	3990691.326	190122.624	449.841	477.874
N047	35°59'59.35604"N	114°25'09.50981"W	3989338.402	191768.182	490.531	518.541
N048	35°51'07.23663"N	114°30'55.13749"W	3973242.871	182519.018	583.723	611.922
N049	35°51'28.40403"N	114°30'00.86736"W	3973846.499	183904.415	590.948	619.129
N050	35°51'41.57573"N	114°29'26.95239"W	3974222.088	184770.023	607.968	636.133
N051	35°52'07.81175"N	114°28'20.41736"W	3974971.352	186468.389	637.774	665.903
N052	35°52'31.15106"N	114°27'22.83026"W	3975639.571	187938.789	672.250	700.343
N053	35°53'00.11622"N	114°26'35.65068"W	3976490.649	189153.971	688.923	716.981
N054	35°53'21.86421"N	114°26'03.91963"W	3977133.026	189973.577	707.359	735.393
N055	35°53'14.43779"N	114°24'47.46455"W	3976836.833	191883.407	775.829	803.813
N056	35°52'31.99760"N	114°22'34.45913"W	3975412.562	195174.595	879.196	907.084
N057	35°51'12.83934"N	114°23'06.82726"W	3973000.549	194277.963	912.603	940.527
N058	35°50'05.92840"N	114°22'48.87924"W	3970922.373	194657.036	952.185	980.110
N059	35°49'23.60013"N	114°22'32.76981"W	3969603.601	195016.351	981.095	1009.018
N060	35°47'47.31067"N	114°22'17.31414"W	3966622.035	195302.054	1005.953	1033.894
N061	35°48'20.35870"N	114°22'32.63964"W	3967654.031	194952.330	984.499	1012.442

Name	Latitude NAD83	Longitude NAD83	UTM North (m)	UTM East (m)	Height WGS84(m)	Elevation GEOID03 (m)
N062	35°48'35.69547"N	114°23'24.09769"W	3968171.484	193676.570	935.139	963.121
N063	35°48'54.47730"N	114°24'29.13319"W	3968807.202	192063.742	872.750	900.780
N064	35°49'11.64070"N	114°25'32.75685"W	3969392.098	190484.819	820.297	848.369
N065	35°49'27.89336"N	114°26'31.87579"W	3969945.233	189018.184	769.942	798.052
N066	35°49'42.93893"N	114°27'25.77330"W	3970456.778	187681.474	726.139	754.278
N067	35°49'57.56912"N	114°28'17.25132"W	3970953.573	186405.182	684.476	712.639
N068	35°50'16.22035"N	114°29'27.93625"W	3971591.726	184651.321	629.782	657.970
N069	35°49'55.74929"N	114°29'56.91591"W	3970986.678	183901.299	615.571	643.775
N070	35°49'12.25631"N	114°29'28.46711"W	3969620.391	184567.576	640.642	668.849
N071	35°48'32.79807"N	114°29'14.73353"W	3968391.715	184869.006	652.633	680.848
N072	35°50'15.28726"N	114°31'11.31684"W	3971656.035	182055.279	606.645	634.861
N073	35°50'14.35221"N	114°33'08.94677"W	3971734.043	179101.506	638.330	666.562
N074	35°50'14.94685"N	114°34'40.82979"W	3971836.513	176795.716	650.086	678.343
N075dem	35°47'56.09986"N	114°31'18.40347"W	3967371.692	181722.853	654.748	683.000
N075p	35°47'56.09986"N	114°31'18.40347"W	3967371.692	181722.853	654.479	682.731
N076dem	35°47'36.31496"N	114°30'17.07506"W	3966706.472	183241.197	635.751	664.000
N076p	35°47'36.31496"N	114°30'17.07506"W	3966706.472	183241.197	634.825	663.074
N077	35°45'14.31606"N	114°30'01.87553"W	3962315.436	183466.404	699.627	727.919
N078	35°45'34.11289"N	114°29'15.19002"W	3962883.852	184661.246	666.658	694.941
N079	35°45'49.23193"N	114°28'20.31750"W	3963300.922	186056.503	681.326	709.588
N080	35°45'49.40265"N	114°27'01.86370"W	3963236.503	188027.806	726.700	754.924
N081	35°45'50.39329"N	114°26'03.19809"W	3963215.222	189502.814	770.568	798.752
N082	35°45'51.34060"N	114°25'18.30539"W	3963204.937	190631.727	809.293	837.442
N083	35°45'51.58048"N	114°24'27.72832"W	3963168.017	191902.681	854.169	882.273
N084	35°46'01.76253"N	114°23'29.50140"W	3963431.095	193376.437	907.796	935.842
N085	35°45'25.79336"N	114°23'32.47469"W	3962324.910	193263.328	895.347	923.414
N086	35°44'21.67619"N	114°23'43.08096"W	3960357.694	192928.327	829.349	857.457
N087	35°44'58.70144"N	114°23'53.53943"W	3961508.133	192705.078	855.970	884.069
N088	35°44'20.69371"N	114°24'22.52009"W	3960361.812	191936.101	808.553	836.698
N089	35°43'42.58528"N	114°24'52.14822"W	3959213.009	191150.555	776.699	804.890
N090	35°44'08.05612"N	114°26'00.83905"W	3960058.496	189451.499	746.138	774.371
N091	35°44'38.01073"N	114°25'29.96014"W	3960954.712	190259.863	777.695	805.889
N092	35°43'01.19110"N	114°27'05.90840"W	3958054.766	187743.498	718.403	746.710
N093	35°43'39.54761"N	114°27'11.86405"W	3959242.422	187635.437	713.235	741.527
N094	35°44'31.78380"N	114°27'05.59527"W	3960847.112	187849.730	716.814	745.077
N095	35°44'25.76842"N	114°27'33.40720"W	3960686.333	187144.233	702.669	730.948
N096	35°42'21.30996"N	114°30'19.83378"W	3956998.370	182824.361	754.691	783.066
N097	35°43'04.73203"N	114°30'02.51431"W	3958321.366	183307.626	738.273	766.626
N098	35°41'47.29853"N	114°29'12.44066"W	3955889.500	184481.553	732.818	761.200
N099	35°41'24.95851"N	114°30'03.26887"W	3955246.368	183178.842	764.922	793.318
N100	35°40'52.74714"N	114°29'40.83042"W	3954233.284	183707.752	767.771	796.175

Name	Latitude NAD83	Longitude NAD83	UTM North (m)	UTM East (m)	Height WGS84(m)	Elevation GEOID03 (m)
N101	35°41'24.41618"N	114°31'03.65797"W	3955283.985	181659.569	810.139	838.544
N102	35°40'41.58643"N	114°31'44.52414"W	3954000.598	180584.357	880.132	908.571
N103	35°40'36.89202"N	114°31'00.90059"W	3953816.486	181676.392	821.952	850.375
N104	35°39'40.16461"N	114°30'49.97812"W	3952057.931	181888.503	849.795	878.234
N105	35°39'51.75505"N	114°29'44.47122"W	3952356.378	183549.204	809.345	837.765
N106	35°39'11.46612"N	114°30'02.41348"W	3951130.502	183053.553	849.529	877.961
N107	35°40'01.48658"N	114°28'50.13198"W	3952607.784	184926.807	778.525	806.937
N108	35°39'04.17431"N	114°29'09.04954"W	3950857.950	184388.193	834.178	862.603
N109	35°40'50.30994"N	114°28'47.67467"W	3954110.633	185041.995	748.798	777.198
N110	35°42'21.45290"N	114°26'01.73514"W	3956773.143	189313.855	754.128	782.416
N111	35°41'29.34960"N	114°27'05.26178"W	3955223.083	187660.102	737.779	766.131
N112	35°40'41.18447"N	114°27'05.81063"W	3953738.831	187594.062	736.865	765.239
N113	35°41'29.03409"N	114°26'01.60397"W	3955157.173	189260.577	769.356	797.671
N114	35°41'29.01465"N	114°24'57.44039"W	3955100.236	190874.082	803.419	831.686
N115	35°40'50.46437"N	114°24'29.76550"W	3953887.694	191528.737	811.142	839.410
N116	35°41'01.58029"N	114°23'52.15913"W	3954197.542	192486.413	838.568	866.798
N117	35°41'00.77652"N	114°23'16.89647"W	3954142.096	193372.386	858.146	886.346
N118	35°40'41.32816"N	114°25'07.05059"W	3953638.688	190581.191	790.584	818.886
N119	35°40'33.08441"N	114°25'52.40015"W	3953424.381	189431.707	765.732	794.070
N120	35°40'25.50376"N	114°26'33.22976"W	3953226.671	188396.559	746.091	774.458
N121	35°40'15.08926"N	114°27'32.25698"W	3952957.844	186900.541	734.423	762.817
PAI120	35°33'38.72296"N	114°21'45.27172"W	3940436.582	195210.355	847.667	876.111
PAI130	35°34'30.93639"N	114°20'41.92946"W	3941991.661	196860.511	864.330	892.685
PAI131	35°34'31.10763"N	114°21'45.09178"W	3942051.168	195270.073	843.296	871.704
PAI135	35°35'23.12195"N	114°15'11.92812"W	3943321.512	205224.004	1146.069	1174.025
PAI136	35°35'22.37514"N	114°17'30.08638"W	3943414.246	201744.710	952.820	980.938
PAI137	35°35'23.08116"N	114°18'34.00887"W	3943490.026	200135.995	922.441	950.628
PAI139	35°35'22.97716"N	114°20'41.87405"W	3943595.746	196916.462	866.232	894.547
PAI140	35°35'22.76765"N	114°21'45.17189"W	3943643.643	195322.497	842.140	870.511
PAI141	35°35'23.94469"N	114°22'49.11866"W	3943735.127	193713.650	820.124	848.538
PAI146	35°35'59.83607"N	114°16'36.84605"W	3944524.170	203123.675	1014.499	1042.530
PAI147	35°36'03.68614"N	114°19'37.65686"W	3944795.725	198575.806	907.222	935.440
PAI148	35°36'15.51288"N	114°18'34.00104"W	3945106.187	200190.591	951.509	979.652
PAI149	35°36'13.82326"N	114°20'42.00224"W	3945163.167	196966.557	878.990	907.263
PAI150	35°36'15.49367"N	114°21'45.22974"W	3945268.961	195376.626	845.014	873.343
PAI151	35°36'15.24068"N	114°22'49.05237"W	3945316.266	193769.683	821.844	850.221
PAI153	35°36'41.75081"N	114°18'06.83620"W	3945891.955	200901.593	1010.714	1038.807
PAI154	35°37'02.37769"N	114°18'33.85656"W	3946550.639	200242.867	992.388	1020.491
PAI155	35°37'07.55035"N	114°20'25.74309"W	3946805.365	197432.151	931.983	960.192
PAI158	35°37'46.28274"N	114°25'35.38453"W	3948267.661	189680.237	775.518	803.926
PAI160	35°37'56.21888"N	114°20'10.53951"W	3948292.553	197865.754	990.345	1018.498

Name	Latitude NAD83	Longitude NAD83	UTM North (m)	UTM East (m)	Height WGS84(m)	Elevation GEOID03 (m)
PAI162	35°39'15.35022"N	114°24'52.11290"W	3950975.290	190864.691	762.899	791.244
S002	35°31'01.96294"N	114°21'47.10674"W	3935606.098	194999.083	867.353	895.883
S003	35°31'01.10771"N	114°22'49.30699"W	3935633.388	193430.643	858.646	887.203
S004	35°31'02.39891"N	114°23'53.57353"W	3935728.914	191812.393	878.248	906.820
S005	35°31'02.86761"N	114°24'56.96243"W	3935798.614	190215.386	898.785	927.364
S006	35°31'02.17094"N	114°26'00.90605"W	3935833.165	188603.143	928.976	957.560
S007	35°31'02.30544"N	114°26'48.90957"W	3935879.562	187393.503	960.864	989.452
S008	35°31'02.33405"N	114°27'42.94457"W	3935928.201	186031.738	1009.825	1038.424
S009	35°30'39.58878"N	114°28'22.31742"W	3935261.992	185014.737	1048.771	1077.403
S010	35°30'53.45612"N	114°29'21.50036"W	3935742.172	183538.212	1117.502	1146.151
S011	35°31'25.57298"N	114°29'43.58373"W	3936751.936	183016.775	1179.351	1207.988
S012	35°31'47.44675"N	114°30'15.00934"W	3937454.360	182248.827	1258.253	1286.897
S013	35°30'10.21813"N	114°28'57.92249"W	3934388.300	184085.333	1067.239	1095.917
S014	35°30'12.65177"N	114°30'00.76883"W	3934519.452	182503.831	1105.918	1134.640
S015	35°30'09.67014"N	114°28'08.22926"W	3934327.223	185337.348	1025.568	1054.224
S016	35°29'23.98409"N	114°21'07.10885"W	3932551.608	195904.353	887.896	916.447
S017	35°29'42.65561"N	114°26'54.90621"W	3933429.616	187156.442	975.504	1004.156
S018	35°29'21.71055"N	114°29'00.03620"W	3932894.903	183979.203	1065.077	1093.803
S019	35°29'09.35774"N	114°30'15.88019"W	3932581.893	182053.545	1143.020	1171.820
S020	35°29'52.50284"N	114°30'58.99591"W	3933950.598	181013.942	929.315	958.116
S021	35°29'58.58699"N	114°32'43.24160"W	3934232.308	178392.774	697.701	726.637
S022	35°28'30.90913"N	114°28'47.28027"W	3931317.558	184245.519	1061.849	1090.614
S023	35°28'19.29614"N	114°29'15.05355"W	3930984.322	183532.539	1092.382	1121.178
S024	35°27'45.54145"N	114°29'10.87138"W	3929940.083	183601.217	1092.772	1121.599
S025	35°26'45.39198"N	114°29'19.86100"W	3928093.953	183308.931	1087.665	1116.561
S026	35°26'07.93886"N	114°28'36.87991"W	3926901.175	184352.443	999.193	1028.091
S027	35°25'48.49465"N	114°27'57.86609"W	3926267.184	185315.634	930.917	959.801
S028	35°27'44.00651"N	114°27'55.19135"W	3929825.509	185508.164	1033.113	1061.891
S029	35°26'48.63681"N	114°27'56.45390"W	3928119.835	185416.364	1049.020	1077.849
S030	35°27'39.04643"N	114°27'09.78678"W	3929632.457	186647.889	1011.359	1040.118
S031	35°28'31.53320"N	114°27'56.12260"W	3931291.364	185536.160	1026.660	1055.397
S032	35°28'31.84812"N	114°26'54.90567"W	3931246.953	187080.102	990.624	1019.333
S033	35°29'23.82277"N	114°27'55.91542"W	3932903.032	185598.044	1013.412	1042.104
S034	35°30'09.24054"N	114°20'35.18400"W	3933919.273	196756.487	897.697	926.202
S035	35°30'09.63199"N	114°21'45.17993"W	3933991.366	194992.591	872.287	900.840
S036	35°30'09.90461"N	114°22'49.20165"W	3934054.979	193379.148	866.193	894.773
S037	35°30'10.00445"N	114°23'52.92198"W	3934113.296	191773.112	889.624	918.221
S038	35°30'10.11928"N	114°25'50.48647"W	3934219.513	188809.866	937.046	965.664
S039	35°30'10.03993"N	114°24'57.02012"W	3934170.249	190157.475	915.823	944.432
S040	35°29'24.88571"N	114°25'50.47196"W	3932825.168	188761.696	957.163	985.809
S041	35°28'37.96339"N	114°25'02.61008"W	3931336.876	189918.173	940.695	969.360

Name	Latitude NAD83	Longitude NAD83	UTM North (m)	UTM East (m)	Height WGS84(m)	Elevation GEOID03 (m)
S042	35°28'31.55833"N	114°25'53.43501"W	3931183.946	188629.780	958.360	987.045
S043	35°27'39.48183"N	114°25'43.19629"W	3929569.705	188832.143	948.635	977.355
S044	35°26'47.16657"N	114°25'27.24230"W	3927943.114	189178.526	955.665	984.415
S045	35°26'47.01649"N	114°24'46.56317"W	3927902.940	190204.458	927.965	956.695
S046	35°25'54.97258"N	114°24'46.68361"W	3926298.803	190145.944	945.383	974.145
S047	35°25'55.00568"N	114°25'42.02594"W	3926348.206	188749.769	967.704	996.497
S048	35°25'55.08330"N	114°26'54.18029"W	3926414.007	186929.489	1011.771	1040.606
S049	35°25'59.20550"N	114°25'58.09284"W	3926491.753	188348.925	1015.971	1044.770
S050	35°25'02.98452"N	114°24'46.60033"W	3924696.213	190092.648	961.778	990.570
S051	35°25'02.54604"N	114°25'41.80347"W	3924730.949	188699.231	969.391	998.219
S052	35°24'11.84711"N	114°23'41.17979"W	3923063.027	191689.224	989.822	1018.596
S053	35°23'58.02942"N	114°24'47.81557"W	3922695.052	189992.792	1001.174	1030.004
S054	35°23'22.99399"N	114°25'20.84643"W	3921643.937	189121.725	1014.704	1043.584
S055	35°25'07.09736"N	114°23'27.56813"W	3924754.287	192091.219	963.295	992.036
S056	35°28'32.18904"N	114°23'42.98221"W	3931089.524	191919.804	894.549	923.195
S057	35°28'31.40495"N	114°22'26.32208"W	3930999.009	193851.932	887.293	915.913
S058	35°28'31.45375"N	114°21'35.56060"W	3930956.811	195131.909	894.862	923.456
S059	35°27'45.01019"N	114°21'35.34296"W	3929525.033	195088.628	905.707	934.321
S060	35°26'52.86053"N	114°21'35.32595"W	3927917.543	195034.316	916.316	944.951
S061	35°26'00.43935"N	114°21'36.39374"W	3926302.618	194952.371	937.314	965.967
S062	35°25'55.14371"N	114°22'35.86441"W	3926190.578	193446.480	933.074	961.764
S063	35°26'47.31359"N	114°22'39.41483"W	3927801.748	193411.942	915.762	944.435
S064	35°26'47.30695"N	114°23'43.34621"W	3927856.884	191799.346	921.873	950.576
S065	35°27'39.37801"N	114°23'39.47996"W	3929458.601	191952.087	906.019	934.693
S066	35°27'38.15607"N	114°22'47.33330"W	3929375.780	193265.895	899.505	928.158
S067	35°25'55.15881"N	114°23'43.53375"W	3926249.602	191739.315	941.138	969.866
S068	35°25'09.18801"N	114°22'18.21867"W	3924758.810	193843.274	959.200	987.895
S069	35°24'08.19773"N	114°21'30.23150"W	3922837.577	194990.168	999.819	1028.508
S070	35°23'13.26783"N	114°21'24.51054"W	3921139.508	195077.027	1056.865	1085.572
S071	35°23'26.04244"N	114°20'29.50891"W	3921486.221	196478.696	1027.814	1056.482
S072	35°23'49.93335"N	114°19'36.06198"W	3922177.111	197852.533	1003.258	1031.883
S073	35°24'01.11735"N	114°18'23.88567"W	3922460.693	199685.698	981.687	1010.255
S074	35°23'17.81337"N	114°18'05.16755"W	3921110.116	200113.500	999.324	1027.904
S075	35°23'12.47533"N	114°17'24.20502"W	3920911.099	201141.967	997.718	1026.273
S076	35°22'44.58629"N	114°16'33.42785"W	3920008.895	202395.171	1010.594	1039.133
S077	35°24'11.91080"N	114°15'11.35508"W	3922632.073	204555.607	1075.782	1104.162
S078	35°24'23.20017"N	114°15'57.02047"W	3923018.069	203414.690	1050.238	1078.656
S079	35°24'49.73413"N	114°15'16.18130"W	3923801.914	204472.222	1089.455	1117.802
S080	35°24'24.62993"N	114°17'20.14245"W	3923131.732	201318.543	1015.876	1044.374
S081	35°23'53.90909"N	114°17'05.51090"W	3922172.528	201656.290	1010.803	1039.311
S082	35°25'44.73189"N	114°15'30.62067"W	3925509.130	204163.814	1115.695	1144.006

Name	Latitude NAD83	Longitude NAD83	UTM North (m)	UTM East (m)	Height WGS84(m)	Elevation GEOID03 (m)
S083	35°26'17.79890"N	114°14'46.43595"W	3926491.636	205312.024	1161.460	1189.686
S084	35°26'04.52985"N	114°17'00.67396"W	3926194.641	201912.226	1063.071	1091.472
S085	35°26'53.24921"N	114°17'23.54079"W	3927715.548	201385.428	1019.049	1047.444
S086	35°27'21.62789"N	114°18'03.94430"W	3928624.315	200395.617	972.298	1000.726
S087	35°27'43.92175"N	114°17'22.71418"W	3929276.761	201458.354	1010.791	1039.155
S088	35°28'39.24682"N	114°16'50.26083"W	3930954.820	202333.483	1069.689	1097.979
S089	35°29'24.21869"N	114°18'58.98036"W	3932449.589	199134.672	950.925	979.358
S090	35°29'45.62745"N	114°18'24.29494"W	3933080.116	200031.209	972.098	1000.479
S091	35°25'34.98418"N	114°16'52.58589"W	3925277.158	202085.992	1048.583	1076.998
S092dem	35°25'55.12467"N	114°16'33.60748"W	3925882.056	202585.400	1058.623	1087.000
S092p	35°25'55.12467"N	114°16'33.60748"W	3925882.056	202585.400	1053.237	1081.614
S093	35°25'12.90549"N	114°17'17.27063"W	3924617.336	201440.554	1034.429	1062.888
S094	35°25'14.79866"N	114°18'26.42528"W	3924733.960	199697.652	990.790	1019.314
S095	35°25'08.37672"N	114°19'21.23536"W	3924582.437	198308.068	961.121	989.697
S096	35°26'00.34531"N	114°18'35.01693"W	3926145.138	199527.938	982.255	1010.762
S097	35°26'00.54397"N	114°19'30.64060"W	3926198.418	198124.912	955.033	983.592
S098	35°26'52.66696"N	114°19'51.81716"W	3927823.065	197644.908	938.397	966.953
S099	35°26'52.71535"N	114°18'59.02546"W	3927779.707	198976.510	958.242	986.747
S100	35°28'36.66518"N	114°19'31.06943"W	3931011.050	198276.285	931.446	959.936
S101	35°27'47.51660"N	114°19'31.07495"W	3929496.100	198225.067	930.202	958.714
S102	35°28'36.82419"N	114°20'34.14129"W	3931069.720	196686.171	904.477	933.025
S103	35°27'45.01349"N	114°20'35.08168"W	3929473.503	196608.327	913.329	941.900
S104	35°26'00.38726"N	114°20'35.19561"W	3926248.593	196496.194	936.620	965.232
S105	35°25'08.30542"N	114°20'34.58060"W	3924642.697	196457.354	960.822	989.452
S106	35°25'08.38463"N	114°21'35.20048"W	3924697.050	194927.872	961.551	990.218
S107	35°31'02.34943"N	114°19'53.51113"W	3935520.738	197862.235	910.074	938.517
S108	35°31'03.81306"N	114°16'25.89065"W	3935390.443	203095.941	1018.914	1047.103
S109	35°31'02.06390"N	114°15'45.98024"W	3935303.161	204099.914	1041.663	1069.797
S110	35°31'54.09634"N	114°17'29.78237"W	3936994.018	201537.632	965.984	994.236
S111	35°31'54.27609"N	114°18'33.69170"W	3937053.526	199927.540	936.474	964.802
S112	35°31'54.32108"N	114°19'37.61924"W	3937109.187	198316.841	910.232	938.631
S113	35°31'55.66060"N	114°20'41.35134"W	3937204.874	196712.414	886.895	915.352
S114	35°32'46.02423"N	114°19'37.21364"W	3938702.550	198380.913	902.086	930.453
S115	35°32'46.89402"N	114°15'22.46531"W	3938514.784	204799.340	1051.047	1079.102
S116	35°33'35.45540"N	114°15'22.32137"W	3940011.498	204852.483	1067.274	1095.303
S117	35°34'30.91969"N	114°15'21.60421"W	3941720.510	204927.118	1101.366	1129.362
S118	35°34'30.56635"N	114°14'32.83748"W	3941669.059	206154.812	1178.898	1206.836
S120	35°33'38.77256"N	114°18'33.95984"W	3940274.759	200029.066	921.579	949.844
S121	35°33'38.32694"N	114°17'30.47647"W	3940207.394	201627.572	960.897	989.090
S122	35°34'30.92665"N	114°18'34.47807"W	3941882.802	200070.087	923.110	951.339
S123	35°34'30.95730"N	114°19'37.53304"W	3941937.310	198482.222	891.572	919.866

Name	Latitude NAD83	Longitude NAD83	UTM North (m)	UTM East (m)	Height WGS84(m)	Elevation GEOID03 (m)
T S12-S13S17-S18	35°28'31.59255"N	114°27'56.05986"W	3931293.138	185537.807	1027.030	1055.767
T S18-S19	35°27'44.96817"N	114°21'35.18705"W	3929523.604	195092.516	906.222	934.836
T S19-S30	35°26'52.76755"N	114°21'35.16721"W	3927914.541	195038.222	916.763	945.398
T S31 S36	35°35'49.54735"N	114°21'45.06367"W	3944469.028	195353.451	842.758	871.107
T26N R20 S26 S25	35°36'15.55245"N	114°22'49.06559"W	3945325.888	193769.681	822.319	850.696
T26N R20W R19W	35°36'15.67486"N	114°21'45.06260"W	3945274.402	195381.024	845.623	873.952
VJ	35°42'08.08069"N	114°28'30.33741"W	3956492.559	185562.981	712.753	741.119
W01	35°37'47.19716"N	114°27'02.43772"W	3948372.536	187490.387	782.484	810.907
W02	35°37'31.68455"N	114°27'24.06656"W	3947913.483	186929.234	799.330	827.755
W03	35°37'54.03819"N	114°28'14.00965"W	3948646.872	185696.602	806.829	835.251
W04	35°38'10.36498"N	114°29'03.98485"W	3949194.690	184456.764	831.196	859.624
W05	35°36'56.33112"N	114°27'44.60552"W	3946841.885	186373.904	854.046	882.470
W06	35°36'21.90202"N	114°27'48.29653"W	3945783.852	186243.595	907.312	935.736
W07	35°36'55.33281"N	114°26'49.90082"W	3946762.701	187749.807	827.246	855.672
W08	35°37'03.31140"N	114°25'52.59950"W	3946958.167	189200.735	799.460	827.883
W09	35°36'14.90644"N	114°25'04.38559"W	3945423.772	190362.404	808.224	836.654
W10	35°35'36.09582"N	114°24'25.71129"W	3944193.625	191294.547	805.768	834.209
W11	35°33'38.68825"N	114°23'54.75609"W	3940547.554	191948.888	829.685	858.182
W12	35°33'39.16296"N	114°24'57.67714"W	3940617.064	190364.537	850.724	879.220
W13	35°33'42.51610"N	114°26'01.03633"W	3940775.971	188772.242	896.350	924.836
W14	35°34'00.46236"N	114°26'01.06171"W	3941329.194	188790.908	892.295	920.772
W15	35°34'31.19494"N	114°25'37.29842"W	3942255.669	189422.420	864.968	893.434
W16	35°35'01.28491"N	114°25'27.13688"W	3943174.292	189710.616	848.979	877.435
W17	35°34'57.33478"N	114°26'33.12892"W	3943110.540	188044.603	900.763	929.209
W18	35°34'31.30571"N	114°27'30.28357"W	3942358.671	186577.147	972.174	1000.623
W19	35°34'39.80551"N	114°28'00.49178"W	3942647.464	185825.621	987.268	1015.715
W20	35°34'59.59470"N	114°28'20.17517"W	3943274.969	185351.466	1024.908	1053.350
W21	35°35'01.87933"N	114°28'50.37580"W	3943372.278	184593.459	1065.538	1093.987
W22	35°33'51.90487"N	114°28'07.38252"W	3941177.007	185600.025	1052.954	1081.424
W23	35°32'33.00147"N	114°27'34.68586"W	3938715.763	186338.067	1003.711	1032.234
W24	35°32'20.23052"N	114°28'08.79656"W	3938352.333	185464.800	1063.483	1092.022
W25	35°31'54.47725"N	114°27'05.05447"W	3937502.030	187042.978	971.795	1000.347
W26	35°31'54.39894"N	114°28'06.67819"W	3937554.177	185490.122	1046.440	1075.001
W27	35°31'54.52946"N	114°26'01.16014"W	3937447.354	188653.008	916.526	945.077
W28	35°31'54.24426"N	114°24'56.60906"W	3937381.995	190279.216	881.894	910.445
W29	35°31'54.40938"N	114°23'53.33456"W	3937331.924	191873.730	862.511	891.058
W30	35°31'54.18308"N	114°22'48.98475"W	3937269.143	193494.913	845.437	873.969
W31	35°32'46.45908"N	114°23'54.20938"W	3938937.114	191907.067	846.053	874.574
W32	35°32'46.79677"N	114°24'45.55787"W	3938992.277	190613.826	861.725	890.248
W33	35°32'44.49477"N	114°25'37.10281"W	3938966.430	189312.800	889.632	918.153

Appendix D

Gravity Results

Table 6. Gravity results. Meter is the gravity meter used to make the gravity measurement; Obs Date is the observation date; G_obs is the observed gravity value in mgal; G_n is the normal gravity (or theoretical gravity) in mgal; FAC is the free-air correction in mgal; BC is the Bouguer correction in mgal; TTC is the total terrain correction (sum of the inner zone correction and the outer zone correction) in mgal; CC is the curvature correction in mgal; CBA is the Complete Bouguer Anomaly in mgal.

Name	Meter	Obs Date	G_obs(mgal)	G_n(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
Base2	Both	Various	979460.664	979778.445	278.063	100.875	0.459	1.032	-141.166
Base3	Both	Various	979528.771	979792.604	229.622	83.302	0.460	0.894	-117.947
DolanCA	Both	Various	979446.531	979784.319	339.200	123.054	1.134	1.183	-121.691
MAT126	711395	02/06/2006	979514.354	979788.937	239.170	86.766	0.547	0.923	-122.554
MAT132	711395	02/06/2006	979503.921	979787.192	245.361	89.011	0.592	0.941	-127.271
MAT133	711395	02/06/2006	979508.332	979788.104	243.989	88.514	0.582	0.937	-124.652
MAT135	711395	02/06/2006	979501.233	979787.495	250.325	90.812	0.651	0.955	-127.054
MAT136	711395	02/06/2006	979496.012	979786.788	254.693	92.397	0.667	0.968	-128.781
MAT137	711395	02/06/2006	979490.828	979786.140	261.010	94.688	0.702	0.986	-129.275
MAT141	711395	02/06/2006	979497.460	979786.063	249.918	90.665	0.603	0.954	-129.701
MAT142	711395	02/06/2006	979494.001	979784.937	252.562	91.624	0.598	0.962	-130.362
MAT169	711395	02/06/2006	979468.300	979780.683	266.812	96.793	0.491	1.002	-142.876
MAT171	711395	02/06/2006	979479.229	979785.184	271.402	98.458	0.771	1.014	-133.254
MAT172	711395	02/06/2006	979473.010	979785.000	289.045	104.859	0.738	1.061	-128.126
MAT173	711395	02/06/2006	979471.392	979783.141	284.936	103.368	0.581	1.051	-130.651
MAT174	711395	02/06/2006	979467.809	979786.052	303.319	110.037	0.845	1.098	-125.214
N003	711395	11/14/2005	979568.900	979801.920	218.081	79.115	0.370	0.858	-94.542
N004	711395	11/14/2005	979577.918	979804.370	201.069	72.943	0.347	0.804	-98.784
N005	711395	11/14/2005	979593.177	979808.646	177.854	64.521	0.516	0.726	-102.346
N006	711395	11/14/2005	979608.444	979812.394	160.973	58.398	0.684	0.668	-101.358
N007	711395	11/14/2005	979607.051	979812.105	162.895	59.094	0.749	0.674	-101.179
N008	711395	11/14/2005	979614.503	979815.666	161.374	58.543	0.818	0.669	-98.183
N009	711395	11/14/2005	979598.280	979816.479	197.417	71.618	1.029	0.792	-92.164
N010	711395	11/14/2005	979589.330	979816.966	222.556	80.738	1.398	0.872	-85.292
N011	711395	11/14/2005	979610.956	979820.237	174.449	63.286	0.834	0.715	-97.999
N012	711395	11/14/2005	979616.465	979822.054	165.297	59.966	0.814	0.683	-100.126
N013	711395	11/14/2005	979636.438	979823.784	134.177	48.676	0.660	0.570	-101.756
N014	711395	11/14/2005	979653.198	979823.673	112.655	40.869	0.764	0.487	-98.412
N015	711395	11/14/2005	979634.326	979823.863	138.734	50.329	0.752	0.587	-100.967
N016	711395	11/14/2005	979643.946	979824.753	125.881	45.667	0.708	0.538	-100.423
N017	711395	11/14/2005	979618.368	979823.581	169.511	61.495	0.966	0.698	-96.929
N018	711395	11/14/2005	979611.408	979823.851	187.719	68.100	1.370	0.760	-92.214
N019	711395	11/14/2005	979601.588	979823.533	212.070	76.934	1.826	0.839	-85.822
N020	711395	11/14/2005	979589.714	979823.775	231.093	83.835	2.014	0.898	-85.687
N021	711395	11/14/2005	979574.326	979824.526	249.220	90.411	1.734	0.952	-90.609
N022	711395	11/14/2005	979526.930	979792.935	229.536	83.270	0.449	0.894	-120.185

Name	Meter	Obs Date	G_obs(mgal)	G_n(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
N023	711395	11/14/2005	979526.359	979793.203	232.077	84.192	0.444	0.901	-119.416
N024	711395	11/14/2005	979525.247	979793.689	237.773	86.259	0.480	0.918	-117.365
N025	711395	11/14/2005	979516.341	979794.737	257.263	93.329	0.694	0.975	-114.743
N026	711395	11/14/2005	979479.860	979795.263	302.066	109.583	1.270	1.095	-122.744
N027	711395	11/14/2005	979452.729	979795.302	330.835	120.020	0.729	1.164	-132.192
N028	711395	11/14/2005	979431.768	979795.787	370.085	134.258	1.280	1.248	-128.161
N029	711395	11/14/2005	979429.596	979796.792	372.118	134.996	1.204	1.252	-130.122
N030	711395	11/14/2005	979438.478	979796.802	351.706	127.591	0.864	1.210	-134.556
N031	711395	11/14/2005	979438.930	979794.318	354.118	128.466	0.813	1.215	-130.138
N032	711395	11/14/2005	979456.464	979793.139	327.096	118.663	0.775	1.155	-128.623
N033	711395	11/14/2005	979449.713	979792.210	335.683	121.778	1.016	1.175	-128.751
N034	711395	11/14/2005	979463.089	979794.301	319.379	115.864	0.682	1.137	-128.152
N035	711395	11/14/2005	979467.871	979793.142	311.846	113.131	0.813	1.119	-126.861
N036	711395	11/14/2005	979476.848	979793.128	302.768	109.837	0.996	1.096	-123.449
N037	711395	11/14/2005	979471.351	979796.807	315.100	114.311	0.798	1.127	-124.996
N038	711395	11/15/2005	979577.915	979804.370	201.069	72.943	0.347	0.804	-98.787
N039	711395	11/15/2005	979589.027	979808.890	201.576	73.127	0.585	0.806	-91.635
N040	711395	11/15/2005	979583.179	979809.045	225.848	81.932	0.912	0.882	-81.921
N041	711395	11/15/2005	979564.184	979809.147	257.852	93.543	1.940	0.977	-79.690
N042	711395	11/15/2005	979625.714	979819.081	145.060	52.624	0.696	0.610	-100.845
N043	711395	11/15/2005	979645.023	979821.568	115.345	41.845	0.782	0.498	-102.761
N044	711395	11/15/2005	979640.155	979820.615	120.669	43.776	0.771	0.518	-103.314
N045	711395	11/15/2005	979625.866	979819.747	137.832	50.002	0.576	0.583	-106.058
N046	711395	11/15/2005	979619.210	979819.307	147.472	53.499	0.478	0.619	-106.266
N047	711395	11/15/2005	979610.827	979818.305	160.022	58.052	0.500	0.664	-105.672
N048	711395	11/15/2005	979580.607	979805.610	188.839	68.507	0.402	0.764	-105.032
N049	711395	11/15/2005	979578.319	979806.114	191.063	69.313	0.430	0.771	-106.386
N050	711395	11/15/2005	979574.775	979806.428	196.311	71.217	0.415	0.788	-106.933
N051	711395	11/15/2005	979569.545	979807.054	205.498	74.550	0.448	0.818	-106.931
N052	711395	11/15/2005	979569.628	979807.610	216.126	78.406	0.499	0.852	-100.616
N053	711395	11/15/2005	979564.506	979808.301	221.260	80.268	0.576	0.868	-103.095
N054	711395	11/15/2005	979558.635	979808.820	226.942	82.330	0.855	0.886	-105.603
N055	711395	11/15/2005	979539.994	979808.643	248.057	89.989	0.683	0.949	-110.847
N056	711395	11/15/2005	979515.494	979807.631	279.926	101.551	0.806	1.037	-113.993
N057	711395	11/15/2005	979501.650	979805.743	290.247	105.295	0.849	1.065	-119.358
N058	711395	11/15/2005	979488.900	979804.149	302.462	109.726	0.866	1.096	-122.743
N059	711395	11/15/2005	979479.300	979803.140	311.383	112.963	0.889	1.118	-125.648
N060	711395	11/15/2005	979472.212	979800.846	319.060	115.748	0.882	1.136	-125.576
N061	711395	11/15/2005	979477.423	979801.633	312.440	113.346	0.863	1.120	-125.373
N062	711395	11/15/2005	979490.828	979801.998	297.219	107.824	0.916	1.083	-121.943
N063	711395	11/15/2005	979507.458	979802.446	277.981	100.845	0.754	1.032	-118.130
N064	711395	11/15/2005	979525.223	979802.855	261.807	94.978	0.623	0.988	-111.168
N065	711395	11/15/2005	979541.182	979803.242	246.279	89.344	0.544	0.943	-105.525

Name	Meter	Obs Date	G_obs(mgal)	G_n(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
N066	711395	11/15/2005	979551.465	979803.601	232.770	84.444	0.486	0.903	-104.227
N067	711395	11/15/2005	979557.615	979803.949	219.920	79.782	0.436	0.864	-106.624
N068	711395	11/15/2005	979569.354	979804.394	203.050	73.662	0.410	0.810	-106.052
N069	711395	11/15/2005	979572.950	979803.906	198.669	72.073	0.404	0.796	-104.752
N070	711395	11/15/2005	979566.870	979802.869	206.407	74.880	0.397	0.821	-104.896
N071	711395	11/15/2005	979562.728	979801.929	210.110	76.223	0.395	0.833	-105.753
N072	711395	11/15/2005	979576.929	979804.372	195.918	71.075	0.365	0.787	-103.021
N073	711395	11/15/2005	979579.467	979804.349	205.701	74.624	0.361	0.819	-94.263
N074	711395	11/15/2005	979587.817	979804.363	209.337	75.943	0.642	0.831	-83.341
N075dem	711395	11/15/2005	979567.554	979801.055	210.774	76.464	0.427	0.835	-99.599
N076dem	711395	11/15/2005	979565.961	979800.584	204.910	74.337	0.435	0.816	-104.430
N077	711395	11/16/2005	979553.564	979797.202	224.636	81.493	0.447	0.879	-100.927
N078	711395	11/16/2005	979552.938	979797.673	214.459	77.801	0.476	0.847	-108.448
N079	711395	11/16/2005	979545.916	979798.033	218.979	79.441	0.430	0.861	-113.010
N080	711395	11/16/2005	979534.490	979798.037	232.970	84.516	0.464	0.904	-115.533
N081	711395	11/16/2005	979523.204	979798.061	246.495	89.423	0.539	0.944	-118.190
N082	711395	11/16/2005	979515.560	979798.083	258.435	93.754	0.609	0.978	-118.212
N083	711395	11/16/2005	979509.944	979798.089	272.269	98.773	0.693	1.017	-114.973
N084	711395	11/16/2005	979500.357	979798.332	288.801	104.770	0.790	1.061	-114.215
N085	711395	11/16/2005	979503.772	979797.475	284.966	103.379	0.836	1.051	-112.332
N086	711395	11/16/2005	979516.115	979795.949	264.611	95.995	0.862	0.996	-111.351
N087	711395	11/16/2005	979511.012	979796.830	272.824	98.974	0.745	1.018	-112.242
N088	711395	11/16/2005	979516.970	979795.925	258.205	93.671	0.668	0.978	-114.731
N089	711395	11/16/2005	979520.374	979795.018	248.389	90.110	0.609	0.950	-116.706
N090	711395	11/16/2005	979525.221	979795.624	238.971	86.693	0.511	0.922	-118.536
N091	711395	11/16/2005	979519.664	979796.337	248.697	90.222	0.549	0.951	-118.600
N092	711395	11/16/2005	979528.341	979794.033	230.435	83.596	0.450	0.896	-119.299
N093	711395	11/16/2005	979530.835	979794.946	228.835	83.016	0.442	0.891	-118.741
N094	711395	11/16/2005	979532.676	979796.189	229.931	83.414	0.453	0.895	-117.438
N095	711395	11/16/2005	979535.392	979796.046	225.571	81.832	0.438	0.881	-117.358
N096	711395	11/16/2005	979534.151	979793.084	241.654	87.667	0.519	0.930	-105.356
N097	711395	11/16/2005	979537.664	979794.117	236.581	85.826	0.476	0.915	-106.137
N098	711395	11/16/2005	979529.349	979792.274	234.906	85.219	0.477	0.910	-113.671
N099	711395	11/16/2005	979529.907	979791.743	244.818	88.814	0.552	0.939	-106.219
N100	711395	11/16/2005	979526.183	979790.976	245.700	89.134	0.540	0.942	-108.630
N101	711395	11/16/2005	979529.873	979791.730	258.775	93.878	0.861	0.979	-97.078
N102	711395	11/16/2005	979515.365	979790.711	280.385	101.717	1.215	1.039	-96.503
N103	711395	11/16/2005	979526.341	979790.599	262.426	95.202	0.998	0.990	-97.027
N104	711395	11/16/2005	979521.594	979789.250	271.023	98.321	0.803	1.013	-95.164
N105	711395	11/16/2005	979518.805	979789.526	258.534	93.790	0.615	0.979	-106.341
N106	711395	11/16/2005	979515.189	979788.567	270.939	98.290	0.742	1.013	-101.001
N107	711395	11/16/2005	979517.508	979789.757	249.021	90.339	0.550	0.951	-113.969
N108	711395	11/16/2005	979511.271	979788.394	266.199	96.571	0.705	1.000	-107.790

Name	Meter	Obs Date	G_obs(mgal)	G_n(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
N109	711395	11/16/2005	979522.576	979790.919	239.843	87.010	0.503	0.925	-115.931
N110	711395	11/16/2005	979523.229	979793.087	241.454	87.594	0.477	0.929	-116.450
N111	711395	11/16/2005	979522.092	979791.847	236.428	85.771	0.451	0.914	-119.561
N112	711395	11/16/2005	979519.655	979790.701	236.153	85.671	0.485	0.914	-120.993
N113	711395	11/16/2005	979519.237	979791.840	246.161	89.302	0.468	0.943	-116.218
N114	711395	11/16/2005	979512.633	979791.839	256.658	93.110	0.542	0.973	-116.089
N115	711395	11/16/2005	979507.846	979790.922	259.042	93.975	0.769	0.980	-118.220
N116	711395	11/16/2005	979501.465	979791.187	267.494	97.041	0.970	1.004	-119.303
N117	711395	11/16/2005	979495.839	979791.168	273.526	99.229	0.932	1.020	-121.120
N118	711395	11/16/2005	979513.138	979790.705	252.708	91.677	0.556	0.962	-116.942
N119	711395	11/16/2005	979517.601	979790.509	245.050	88.899	0.506	0.940	-117.190
N120	711395	11/16/2005	979518.396	979790.328	238.998	86.703	0.495	0.922	-120.064
N121	711395	11/16/2005	979519.580	979790.081	235.405	85.400	0.533	0.911	-120.873
PAI120	711395	02/06/2006	979466.881	979780.659	270.368	98.083	0.475	1.012	-142.030
PAI130	711395	02/06/2006	979469.167	979781.899	275.483	99.939	0.505	1.026	-137.709
PAI131	711395	02/06/2006	979470.890	979781.903	269.008	97.590	0.490	1.008	-140.113
PAI135	711395	02/06/2006	979433.019	979783.139	362.304	131.436	2.586	1.232	-117.898
PAI136	711395	02/06/2006	979464.511	979783.121	302.717	109.819	0.815	1.096	-125.992
PAI137	711395	02/06/2006	979470.183	979783.138	293.364	106.426	0.649	1.073	-126.441
PAI139	711395	02/06/2006	979472.674	979783.136	276.057	100.147	0.542	1.027	-135.037
PAI140	711395	02/06/2006	979474.484	979783.131	268.640	97.456	0.517	1.007	-137.954
PAI141	711395	02/06/2006	979476.891	979783.159	261.859	94.996	0.528	0.988	-139.866
PAI146	711395	02/06/2006	979454.065	979784.012	321.725	116.714	0.823	1.143	-125.257
PAI147	711395	02/06/2006	979472.885	979784.103	288.677	104.725	0.950	1.061	-127.378
PAI148	711395	02/06/2006	979469.039	979784.384	302.321	109.675	0.732	1.095	-123.062
PAI149	711395	02/06/2006	979473.625	979784.344	279.981	101.571	0.684	1.038	-132.662
PAI150	711395	02/06/2006	979477.681	979784.384	269.514	97.773	0.583	1.009	-135.388
PAI151	711395	02/06/2006	979480.038	979784.378	262.378	95.185	0.553	0.990	-137.583
PAI153	711395	02/06/2006	979457.058	979785.008	320.576	116.298	0.975	1.140	-123.837
PAI154	711395	02/06/2006	979463.279	979785.498	314.924	114.247	0.768	1.126	-121.901
PAI155	711395	02/06/2006	979470.143	979785.621	296.315	107.496	0.733	1.080	-127.007
PAI158	711395	02/06/2006	979499.934	979786.542	248.092	90.002	0.599	0.949	-128.868
PAI160	711395	02/06/2006	979461.082	979786.778	314.308	114.024	1.217	1.125	-125.320
PAI162	711395	02/06/2006	979510.535	979788.660	244.178	88.582	0.645	0.937	-122.821
S002	411	11/14/2005	979459.646	979776.936	276.469	100.297	0.473	1.028	-141.672
S003	411	11/14/2005	979466.415	979776.915	273.791	99.325	0.480	1.021	-136.576
S004	411	11/14/2005	979468.884	979776.946	279.845	101.521	0.485	1.037	-130.291
S005	411	11/14/2005	979472.260	979776.957	286.185	103.821	0.552	1.054	-122.836
S006	411	11/14/2005	979472.419	979776.941	295.503	107.202	0.667	1.078	-116.631
S007	411	11/14/2005	979468.132	979776.944	305.345	110.772	0.810	1.103	-114.533
S008	411	11/14/2005	979460.482	979776.945	320.458	116.255	1.067	1.140	-112.333
S009	411	11/14/2005	979451.217	979776.405	332.487	120.619	1.260	1.167	-113.226
S010	411	11/14/2005	979443.848	979776.734	353.702	128.315	1.924	1.214	-106.789

Name	Meter	Obs Date	G_obs(mgal)	G_n(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
S011	411	11/14/2005	979433.279	979777.496	372.785	135.238	2.738	1.253	-105.185
S012	411	11/14/2005	979416.888	979778.016	397.136	144.072	4.297	1.299	-105.066
S013	411	11/14/2005	979448.416	979775.707	338.200	122.691	1.432	1.180	-111.530
S014	411	11/14/2005	979445.383	979775.765	350.150	127.026	2.311	1.207	-106.155
S015	411	11/14/2005	979452.727	979775.694	325.334	118.024	1.071	1.151	-115.738
S016	411	11/14/2005	979453.444	979774.610	282.816	102.599	0.503	1.045	-141.491
S017	411	11/14/2005	979462.993	979775.053	309.883	112.418	0.754	1.114	-114.955
S018	411	11/14/2005	979446.552	979774.556	337.548	122.455	1.453	1.179	-112.637
S019	411	11/14/2005	979436.145	979774.263	361.624	131.189	3.399	1.231	-105.514
S020	411	11/14/2005	979479.949	979775.287	295.675	107.264	2.920	1.079	-105.086
S021	411	11/14/2005	979524.581	979775.431	224.240	81.349	2.325	0.877	-106.511
S022	411	11/14/2005	979443.337	979773.350	336.563	122.098	1.447	1.177	-115.277
S023	411	11/14/2005	979440.442	979773.075	345.996	125.519	1.930	1.198	-111.424
S024	411	11/14/2005	979438.960	979772.274	346.125	125.566	1.995	1.198	-111.958
S025	411	11/14/2005	979439.823	979770.847	344.571	125.002	2.726	1.194	-109.924
S026	411	11/14/2005	979454.833	979769.958	317.269	115.098	2.204	1.132	-111.882
S027	411	11/14/2005	979465.070	979769.497	296.195	107.453	2.213	1.080	-114.552
S028	411	11/14/2005	979441.749	979772.237	327.700	118.882	1.134	1.156	-121.692
S029	411	11/14/2005	979437.348	979770.924	332.624	120.669	1.360	1.168	-121.428
S030	411	11/14/2005	979443.444	979772.120	320.980	116.444	1.017	1.141	-124.264
S031	411	11/14/2005	979445.623	979773.365	325.696	118.155	1.049	1.152	-120.304
S032	411	11/14/2005	979453.738	979773.372	314.566	114.117	0.784	1.125	-119.527
S033	411	11/14/2005	979451.145	979774.606	321.593	116.667	0.976	1.142	-118.700
S034	411	11/14/2005	979452.590	979775.684	285.826	103.691	0.506	1.053	-141.506
S035	411	11/14/2005	979457.934	979775.693	277.999	100.852	0.481	1.032	-141.163
S036	411	11/14/2005	979465.687	979775.700	276.127	100.173	0.483	1.027	-134.603
S037	411	11/14/2005	979468.631	979775.702	283.363	102.798	0.480	1.047	-127.073
S038	411	11/14/2005	979469.257	979775.705	298.004	108.109	0.612	1.085	-117.026
S039	411	11/14/2005	979468.903	979775.703	291.452	105.732	0.534	1.068	-121.614
S040	411	11/15/2005	979466.141	979774.631	304.221	110.364	0.637	1.100	-115.097
S041	411	11/15/2005	979464.167	979773.518	299.144	108.523	0.568	1.087	-119.248
S042	411	11/15/2005	979464.257	979773.366	304.602	110.503	0.635	1.101	-115.475
S043	411	11/15/2005	979461.208	979772.130	301.612	109.418	0.851	1.094	-118.971
S044	411	11/15/2005	979452.373	979770.889	303.790	110.208	1.064	1.099	-124.969
S045	411	11/15/2005	979458.102	979770.885	295.236	107.105	0.642	1.077	-125.087
S046	411	11/15/2005	979450.141	979769.651	300.621	109.059	0.645	1.091	-128.393
S047	411	11/15/2005	979448.648	979769.652	307.519	111.561	0.996	1.108	-125.158
S048	411	11/15/2005	979439.835	979769.653	321.131	116.499	1.051	1.141	-125.276
S049	411	11/15/2005	979438.716	979769.751	322.416	116.965	1.101	1.144	-125.627
S050	411	11/15/2005	979445.960	979768.418	305.690	110.897	0.701	1.104	-128.069
S051	411	11/15/2005	979448.690	979768.407	308.050	111.754	0.946	1.110	-123.584
S052	411	11/15/2005	979439.280	979767.205	314.339	114.035	0.716	1.125	-128.030
S053	411	11/15/2005	979439.745	979766.878	317.859	115.312	1.002	1.133	-124.717

Name	Meter	Obs Date	G_obs(mgal)	G_n(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
S054	411	11/15/2005	979439.983	979766.047	322.050	116.832	1.442	1.143	-120.547
S055	411	11/15/2005	979443.231	979768.515	306.142	111.062	0.625	1.105	-130.684
S056	411	11/15/2005	979469.180	979773.381	284.898	103.355	0.546	1.051	-123.162
S057	411	11/15/2005	979457.962	979773.362	282.651	102.539	0.478	1.045	-135.855
S058	411	11/15/2005	979451.276	979773.363	284.979	103.384	0.482	1.051	-141.061
S059	411	11/15/2005	979449.094	979772.261	288.331	104.600	0.484	1.060	-140.012
S060	411	11/15/2005	979448.541	979771.024	291.612	105.790	0.500	1.068	-137.230
S061	411	11/15/2005	979448.117	979769.780	298.097	108.143	0.518	1.085	-132.276
S062	411	11/15/2005	979454.825	979769.655	296.800	107.672	0.556	1.081	-126.227
S063	411	11/15/2005	979457.456	979770.892	291.453	105.732	0.507	1.068	-128.277
S064	411	11/15/2005	979455.735	979770.892	293.348	106.420	0.532	1.073	-128.770
S065	411	11/15/2005	979463.636	979772.127	288.446	104.642	0.508	1.060	-125.239
S066	411	11/15/2005	979458.612	979772.098	286.430	103.910	0.493	1.055	-131.529
S067	411	11/15/2005	979449.574	979769.655	299.301	108.580	0.562	1.088	-129.886
S068	411	11/15/2005	979449.389	979768.565	304.864	110.598	0.665	1.102	-125.346
S069	411	11/15/2005	979438.428	979767.119	317.398	115.145	0.756	1.132	-126.814
S070	411	11/15/2005	979426.030	979765.816	335.008	121.533	0.841	1.173	-126.644
S071	411	11/15/2005	979428.538	979766.119	326.030	118.276	0.630	1.153	-130.350
S072	411	11/15/2005	979427.665	979766.686	318.439	115.523	0.596	1.135	-136.643
S073	411	11/15/2005	979432.577	979766.951	311.765	113.101	0.628	1.119	-136.201
S074	411	11/15/2005	979429.851	979765.924	317.211	115.077	0.672	1.132	-134.399
S075	411	11/15/2005	979427.694	979765.798	316.708	114.894	0.599	1.131	-136.822
S076	411	11/15/2005	979423.527	979765.137	320.676	116.334	0.559	1.140	-137.848
S077	411	11/15/2005	979415.240	979767.207	340.744	123.614	0.698	1.186	-135.325
S078	411	11/15/2005	979421.494	979767.474	332.873	120.759	0.654	1.168	-134.380
S079	411	11/15/2005	979415.306	979768.104	344.954	125.141	0.885	1.195	-133.296
S080	411	11/15/2005	979426.346	979767.508	322.294	116.921	0.569	1.144	-136.365
S081	411	11/15/2005	979425.912	979766.780	320.731	116.354	0.567	1.140	-137.064
S082	411	11/16/2005	979415.622	979769.408	353.040	128.075	1.050	1.213	-128.984
S083	411	11/16/2005	979410.223	979770.192	367.137	133.189	1.373	1.242	-125.890
S084	411	11/16/2005	979422.086	979769.877	336.828	122.194	1.196	1.177	-133.137
S085	411	11/16/2005	979433.799	979771.033	323.241	117.265	1.026	1.146	-131.377
S086	411	11/16/2005	979442.133	979771.706	308.824	112.034	0.842	1.111	-133.053
S087	411	11/16/2005	979438.044	979772.235	320.683	116.337	1.200	1.140	-129.785
S088	411	11/16/2005	979428.509	979773.548	338.836	122.922	1.172	1.182	-129.134
S089	411	11/16/2005	979445.534	979774.615	302.230	109.642	0.640	1.095	-136.948
S090	411	11/16/2005	979445.121	979775.124	308.748	112.007	0.695	1.111	-133.678
S091	411	11/16/2005	979424.866	979769.177	332.362	120.573	0.706	1.167	-132.983
S092dem	411	11/16/2005	979427.000	979769.654	335.448	121.693	0.951	1.174	-129.122
S093	411	11/16/2005	979424.288	979768.653	328.007	118.994	0.606	1.157	-135.903
S094	411	11/16/2005	979433.043	979768.698	314.560	114.115	0.575	1.125	-135.760
S095	411	11/16/2005	979436.934	979768.546	305.420	110.800	0.596	1.103	-137.498
S096	411	11/16/2005	979435.533	979769.778	311.921	113.158	0.602	1.119	-135.999

Name	Meter	Obs Date	G_obs(mgal)	G_n(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
S097	411	11/16/2005	979439.498	979769.783	303.536	110.116	0.568	1.098	-137.395
S098	411	11/16/2005	979442.438	979771.019	298.402	108.253	0.551	1.086	-138.968
S099	411	11/16/2005	979440.845	979771.020	304.510	110.469	0.616	1.101	-136.620
S100	411	11/16/2005	979446.151	979773.487	296.236	107.468	0.597	1.080	-139.050
S101	411	11/16/2005	979446.039	979772.321	295.859	107.331	0.602	1.079	-138.230
S102	411	11/16/2005	979449.145	979773.491	287.932	104.455	0.527	1.059	-141.401
S103	411	11/16/2005	979446.428	979772.261	290.670	105.449	0.525	1.066	-141.153
S104	411	11/16/2005	979442.459	979769.779	297.871	108.061	0.539	1.084	-138.055
S105	411	11/16/2005	979439.933	979768.544	305.345	110.772	0.572	1.103	-134.569
S106	411	11/16/2005	979448.573	979768.546	305.581	110.858	0.560	1.103	-125.793
S107	411	11/16/2005	979453.399	979776.945	289.626	105.070	0.521	1.063	-139.531
S108	411	11/16/2005	979440.863	979776.980	323.136	117.226	1.115	1.146	-130.238
S109	411	11/16/2005	979436.433	979776.938	330.139	119.767	1.696	1.162	-129.599
S110	411	11/16/2005	979449.054	979778.174	306.821	111.308	0.756	1.107	-133.957
S111	411	11/16/2005	979453.460	979778.178	297.738	108.013	0.610	1.084	-135.467
S112	411	11/16/2005	979456.554	979778.179	289.662	105.083	0.522	1.063	-137.588
S113	411	11/16/2005	979458.478	979778.211	282.478	102.476	0.470	1.044	-140.306
S114	411	11/16/2005	979461.559	979779.407	287.138	104.167	0.517	1.057	-135.417
S115	411	11/16/2005	979437.177	979779.428	333.011	120.809	1.350	1.169	-129.867
S116	411	11/16/2005	979436.880	979780.581	338.011	122.623	1.245	1.180	-128.248
S117	411	11/16/2005	979438.437	979781.899	348.521	126.436	1.542	1.203	-121.037
S118	411	11/16/2005	979425.426	979781.890	372.430	135.109	2.068	1.253	-118.329
S120	411	11/16/2005	979461.977	979780.660	293.122	106.338	0.600	1.072	-132.371
S121	411	11/16/2005	979454.732	979780.649	305.233	110.732	0.722	1.103	-131.797
S122	411	11/16/2005	979464.592	979781.899	293.583	106.505	0.595	1.073	-130.707
S123	411	11/16/2005	979468.182	979781.900	283.871	102.982	0.538	1.048	-133.339
W01	411	02/06/2006	979507.086	979786.564	250.246	90.784	0.786	0.955	-120.184
W02	411	02/06/2006	979508.478	979786.195	255.445	92.670	0.983	0.970	-114.928
W03	411	02/06/2006	979514.386	979786.726	257.758	93.509	1.394	0.977	-107.673
W04	411	02/06/2006	979513.675	979787.115	265.280	96.238	1.365	0.998	-104.030
W05	411	02/06/2006	979505.238	979785.354	272.330	98.795	1.479	1.017	-106.119
W06	411	02/06/2006	979497.014	979784.536	288.768	104.759	1.265	1.061	-103.308
W07	411	02/06/2006	979501.035	979785.331	264.060	95.795	0.809	0.994	-116.215
W08	411	02/06/2006	979498.009	979785.520	255.485	92.684	0.644	0.970	-125.036
W09	411	02/06/2006	979494.944	979784.370	258.191	93.666	0.603	0.978	-125.275
W10	411	02/06/2006	979491.260	979783.447	257.437	93.392	0.585	0.976	-128.533
W11	411	02/06/2006	979478.464	979780.658	264.835	96.076	0.547	0.996	-133.884
W12	411	02/06/2006	979485.295	979780.669	271.327	98.431	0.631	1.014	-122.861
W13	411	02/06/2006	979485.457	979780.749	285.404	103.538	0.794	1.052	-113.684
W14	411	02/06/2006	979486.774	979781.175	284.150	103.083	0.788	1.049	-113.595
W15	411	02/06/2006	979490.096	979781.905	275.714	100.023	0.701	1.026	-116.444
W16	411	02/06/2006	979490.640	979782.620	270.776	98.232	0.659	1.013	-119.790
W17	411	02/06/2006	979491.327	979782.526	286.754	104.028	0.862	1.056	-108.667

Name	Meter	Obs Date	G_obs(mgal)	G_n(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
W18	411	02/06/2006	979486.181	979781.908	308.792	112.023	1.238	1.111	-98.830
W19	411	02/06/2006	979486.703	979782.110	313.450	113.712	1.725	1.123	-95.068
W20	411	02/06/2006	979479.180	979782.580	325.064	117.926	1.875	1.150	-95.538
W21	411	02/06/2006	979471.425	979782.634	337.604	122.475	2.789	1.179	-94.470
W22	411	02/06/2006	979471.026	979780.972	333.727	121.069	1.831	1.170	-96.626
W23	411	02/06/2006	979468.263	979779.098	318.547	115.562	1.294	1.135	-107.690
W24	411	02/06/2006	979457.136	979778.794	336.998	122.255	1.675	1.178	-106.418
W25	411	02/06/2006	979468.885	979778.183	308.707	111.992	0.986	1.111	-112.707
W26	411	02/06/2006	979457.354	979778.181	331.745	120.350	1.468	1.166	-109.130
W27	411	02/06/2006	979477.240	979778.184	291.651	105.804	0.726	1.068	-115.439
W28	411	02/06/2006	979476.183	979778.177	280.963	101.927	0.578	1.040	-123.420
W29	411	02/06/2006	979471.343	979778.181	274.980	99.757	0.505	1.024	-132.133
W30	411	02/06/2006	979469.653	979778.176	269.707	97.844	0.495	1.010	-137.174
W31	411	02/06/2006	979475.128	979779.417	269.894	97.911	0.525	1.010	-132.792
W32	411	02/06/2006	979478.780	979779.425	274.731	99.666	0.589	1.024	-126.015
W33	411	02/06/2006	979480.529	979779.371	283.342	102.790	0.700	1.047	-118.637